Engineering Library

DEC 28 1927

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLIV.—No. 3752] LONDON: FRIDAY EVENING, DECEMBER 9, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. ONE CRANE, ELECTRIC OVERHEAD TRAVELLING, 100 Tons.
2. About 570 TONS of STEEL DOG-SPIKES.

Tenders due on the 29th December, 1927, for No. 1, and on the 30th December, 1927, for No. 2.
Forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 7215

Ministry of Transport. ARTERIAL ROADS—GREATER LONDON.
HASTINGS ROAD, KENT.
The Minister is prepared to receive TENDERS for COMPLETION and CONSTRUCTION WORKS on the CARRIAGEWAY and FOOTWAY and for WORKS of SURFACE WATER DRAINAGE, &c., of the Hastings Road, Kent, from Green Street Green to Pratts Bottom.
Form of Tender, conditions of Tender, conditions of contract, bill of quantities and specification may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, upon payment of a deposit of £25. This amount will be returned to the tenderer if his Tender is a bona fide one, and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.
The drawings may be inspected at the offices of the Ministry, and copies of the Tender documents will be available on and after Wednesday, 14th December, 1927.
Tenders on the official form, each accompanied by a fully priced bill of quantities, must be enclosed in sealed envelopes, marked "Tender for Hastings Road Construction," and submitted to the undersigned on or before 10 a.m. on Monday, the 2nd day of January, 1928.
The Minister does not bind himself to accept the lowest or any Tender.
Dated this Third day of December, 1927.
(Sgd.) H. H. PIGGOT,
Assistant Secretary.
Ministry of Transport. 7186

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case, or have completed articles with a civil engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience, and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 7152

Assistant Engineers Required for the RAILWAY DEPARTMENT of NIGERIA for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages; liberal leave on full salary. Candidates, aged 23 to 35, should either possess an engineering degree of a recognised University or should have passed Sections "A" and "B" of the Associate Membership examination of the Institution of Civil Engineers. They should also have had 3 or 4 years' regular training as a Civil Engineer, preferably on Railway Works.—Apply at once by letter, stating age, particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15394. 7196

Assistant Engineers (5) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 35 years of age, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. Must have had proper technical training and preferably have had not less than two years' subsequent experience on large engineering or municipal works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/254. 7172

Civil Engineers Required by the GOVERNMENT of IRAQ for the IRRIGATION DEPARTMENT for two years on probation, leading in the case of satisfactory service to a ten years' contract. Salary Rs. 650, rising to Rs. 800 a month by annual increments of Rs. 50 a month. Free passages and liberal leave on full salary. Candidates, unmarried, and between 23 and 26 years of age, should have passed Sections "A" and "B" of the A.M.I.C.E. examination or held an exempting University Degree, and have had not less than a year's practical experience on engineering work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/223. 7206

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Smithfield Club Show. THE ENGINEER, 9 - 12 - 27.

The Shannon Hydro-Electric Power Scheme No. II. THE ENGINEER, 9 - 12 - 27.

The Centenary of Aluminium. (W. H. H. GEE.) THE ENGINEER, 9 - 12 - 27.

City Refuse Collection and Disposal. (J. B. C. KERSHAW.) THE ENGINEER, 9 - 12 - 27.

Institution of Mechanical Engineers. THE ENGINEER, 9 - 12 - 27.

Automatic Liquid Analysis. THE ENGINEER, 9 - 12 - 27.

Safety in Factories. THE ENGINEER, 9 - 12 - 27.

The Comparison of Cutting Tools. THE ENGINEER, 9 - 12 - 27.

Two Improved Wood-working Machines. THE ENGINEER, 9 - 12 - 27.

Electric Ploughing. THE ENGINEER, 9 - 12 - 27.

INDEX TO ADVERTISEMENTS, PAGE 103.

PUBLIC NOTICES

Assistant Engineer Required by the KENYA and UGANDA RAILWAY for the CONSTRUCTION DEPARTMENT. Salary £600 a year. Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 23-35, should have had experience on Railway Construction. Preference will be given to Associate Members of the Institution of Civil Engineers.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/158. 7171

Civil Engineer Required by the GOVERNMENT of CYPRUS for the PUBLIC WORKS DEPARTMENT for three years' service. Salary £600 a year. Free passages and, if married, for wife and children also, not exceeding four persons beside the candidate selected. Candidates, not over 35 years of age, must be fully qualified Civil Engineers and have had previous colonial experience and special knowledge of an experience in the construction and maintenance of Roads and Buildings. Preference given to Corporate Members of the Institution of Civil Engineers who have a knowledge of modern Greek.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/331. 7197

Temporary Architectural Staff Required by the GOVERNMENT of PALESTINE.
M/346.—ARCHITECT REQUIRED for a period of 2 years. Salary £60 to £70 a month, according to qualifications. Free passages. Candidates must have had not less than 5 years' general experience in an Architect's Office. Preference given to those who have had experience in the writing of specifications and the taking out of quantities and the inspection of building works.
M/347.—ASSISTANT ARCHITECT REQUIRED for a period of one to two years. Salary £40 to £60 a month, according to qualifications. Free passages. Candidates must have had not less than three years' experience in an Architect's Office and must be good and rapid Draughtsmen, and be capable of preparing working drawings, full-sized details.—Apply at once by letter, stating age, qualifications and experience, quoting clearly the number of the vacancy applied for, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1. 7205

PUBLIC NOTICES

Air Ministry. DIRECTORATE OF TECHNICAL DEVELOPMENT.
DRAUGHTSMEN, Grade I., are REQUIRED for Wireless Design Work at the Royal Aircraft Establishment.
Candidates must have had good workshop and technical training, and at least six years' experience in Telephone, Telegraph, or Wireless Design.
Preference given, other things being equal, to ex-Service men.
Starting salary £160 plus Civil Service bonus per annum, on the scale £160-£10-£200 plus Civil Service bonus per annum, giving a present total starting remuneration of £246 a year.
Write, quoting reference No. A 207, giving age and full particulars of training and experience, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 7194

The High Commissioner for India is prepared to receive APPLICATIONS for TWO APPOINTMENTS as ASSISTANT EXECUTIVE ENGINEER in the permanent Engineering Service of the Federated Shan States, Burma. The appointments will be subject to confirmation at the end of a probationary period of two years. Candidates should preferably be between 22 and 24 years of age and unmarried. They must either (1) have obtained a University Degree in Civil Engineering or (2) have passed Sections A and B of the A.M.I.C.E. Examination or (3) have passed the Associateship in Civil Engineering of the City and Guilds Institute (Imperial College of Science and Technology), or have obtained such other Diploma or Distinction in Engineering as may be considered acceptable in any particular case. In addition they must have had at least one year's practical experience of Civil Engineering under a qualified Civil Engineer. Those whose qualifying diploma has been obtained without a college course should have had a full three years of such practical experience.
Pay in accordance with an age scale, e.g., age 23, Rs. 375 per mensem; age 24, Rs. 425 per mensem; plus overseas pay of Rs. 150 per mensem if of non-Asiatic domicile. Free passage to Burma. Provident Fund. The climatic conditions of the Federated Shan States are much more suitable to Europeans than those of Burma proper, the temperature being cooler and the climate healthy. Further particulars and forms of application may be obtained upon request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 19th December, 1927. 7180

PUBLIC NOTICES

Administrative County of LONDON.
The London County Council invites TENDERS for the SUPPLY and DELIVERY of about 150 TONS of CAST IRON PIPING, &c., ranging in size from 24in. to 12in. diameter, to the Southern Outfall Works, Crossness, in the Urban District of Erith, in the County of Kent.
The specification, form of Tender, drawings, &c., may be obtained on application to the Chief Engineer of the Council upon payment of the sum of £2 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained upon personal application, and the contract documents may be inspected before payment of the fee.
Correspondence and remittances by post should be addressed to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, or if personal application is made, applicants should apply in Room 9A at No. 5, Warwick House-street, Cockspur-street, S.W. 1.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract, and in the "London County Council Gazette."
No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Friday, 23rd December, 1927, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
7204 Clerk of the London County Council.

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for 1500 LAMINATED BEARING SPRINGS.
Specification and form of Tender can be obtained at the Company's Offices, 122, Gresham House, Old Broad-street, London, E.C. 2, on or after 5th December, 1927.
A fee of 10s. will be charged for each specification, which is NOT returnable.
Tenders must be submitted not later than NOON on Wednesday, 14th December, 1927.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
Secretary.
5th December, 1927. 7170

City of Hull Waterworks. ENGINE-HOUSE, DUNSWELL PUMPING STATION.
The Water and Gas Committee of the Hull Corporation are prepared to receive DESIGNS and TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE ENGINE-HOUSE at their Dunswell Pumping Station. Approximate dimensions: length, 100ft. by width 51ft. by height 57ft.
Copies of the conditions of contract (including specification and form of Tender, &c.) may be obtained from the undersigned on payment of a deposit of £2, which will be refunded on receipt of a bona fide Tender. Cheques to be made payable to Mr. F. Steadman, City Treasurer, Hull.
Drawings showing the proposed scheme can be inspected at the Waterworks Department, Alfred Gelder-street, Hull.
Designs and Tenders, under sealed cover, and endorsed "Tender for Engine-house, Dunswell," and addressed to the Chairman of the Water and Gas Committee, are to be delivered to the Town Clerk's Office not later than Twelve Noon on Friday, 19th January, 1928.
The Corporation do not bind themselves to accept the lowest or any Tender.
W. D. BINGHAM,
Water and Gas Engineer.
Guildhall, Hull.
December, 1927. 7187

Metropolitan Water Board. TENDER FOR THE SUPPLY OF CAST IRON WELL SEGMENTS.
The Metropolitan Water Board invite TENDERS for the SUPPLY of SEVENTY-TWO CAST IRON WELL SEGMENTS, in accordance with Specification and Drawing No. 1927—62/36, for delivery to their Deptford Pumping Station, Brookmill-road, Deptford, London, S.E. 8. The segments are 5ft. deep, and six of them form a ring 14ft. in diameter.
Tenders must be submitted on the official form, which may be obtained, together with copy of drawing, from the Chief Engineer by personal application at the offices of the Board (Room 156), or upon forwarding a stamped addressed brief envelope.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board, and endorsed "Tender for Well Segments," must be delivered at the offices of the Board (Room 122), not later than 11 a.m. on Tuesday, 3rd January, 1928.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
6th December, 1927. 7213

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 104.
PARTNERSHIPS, Page 3.
BUSINESSES and PREMISES (For Sale, etc.). Page 104.
EDUCATIONAL, Page 2.
MACHINERY, &c., WANTED, Page 3.
AGENCIES, Page 3.
MISCELLANEOUS, Page 4.
FOR HIRE, Page 3.
FOR SALE, Pages 4 and 104.
PATENTS, Page 3.
WORK WANTED, Page 4.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY AT THE DEPTFORD PUMPING STATION, BROOKMILL-ROAD, DEPTFORD, LONDON, S.E. 8.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of ONE TRIPLE-EXPANSION ENGINE with RECIPROCATING PUMPS, THREE STEAM TURBINES with CENTRIFUGAL PUMPS, and ONE WATER-DRIVEN TURBINE with CENTRIFUGAL PUMP, at their Deptford Pumping Station, Brookmill-road, Deptford, London, S.E. 8.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 12th December, 1927.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Three Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board and endorsed "Tender for Machinery, Deptford," must be delivered at the Offices of the Board (Room 122) not later than 10 a.m. on Tuesday, 7th February, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
2nd December, 1927. 7201

The South Indian Railway

COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. PRESSED STEEL SLEEPERS for B.S. 60 R.F.B. RAILS.
2. COMPRESSED AIR MAINS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Pressed Steel Sleepers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 23rd December, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specification No. 1, and of 5s. for each copy of Specification No. 2.

Copies of the drawings may be obtained from the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
9th December, 1927. 7214

Wycombe Rural District Council.

STOKENCHURCH WATER SUPPLY.
EXTENSIONS OF WATER MAINS.

TENDERS are INVITED by the above Council for the PROVISION and LAYING of 840 YARDS of 3in. diameter CAST IRON SOCKET and SPIGOT PIPES (Class B, British Standard Specification), together with the necessary VALVES, SPECIALS, &c.

Specification, form of Tender, and other information may be obtained from the Consulting Engineers, Messrs. Lucas and Pyke, 39, Victoria-street, Westminster, S.W. 1, on payment of a fee of £1, which will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Stokenchurch Water Supply, Mains Extensions," in a sealed envelope, should be addressed to

B. L. REYNOLDS, Esq.,
Clerk to the Wycombe R.D.C.,
High Wycombe, Bucks.,

on or before Wednesday, 21st December, 1927.

The Council do not bind themselves to accept the lowest or any Tender.

High Wycombe, Bucks.,
1st December, 1927. 7200

County Borough of Middlesbrough.

BROUGH EDUCATION COMMITTEE.
CONSTANTINE TECHNICAL COLLEGE.
APPOINTMENT OF PRINCIPAL.

APPLICATIONS are INVITED for the POSITION of PRINCIPAL of the CONSTANTINE TECHNICAL COLLEGE. The main Departments of the College will be those of Metallurgy, Engineering and Naval Architecture. Preference will be given to candidates with special qualifications in Metallurgical Science, together with administrative experience. Salary £900 per annum, with annual increments of £50 to a maximum of £1200. Particulars of the appointment and form of application may be obtained on receipt of a stamped addressed foolscap envelope, and applications should reach the undersigned not later than Saturday, 31st December, 1927.

W. J. WILLIAMS,
Director of Education.

Education Offices,
Middlesbrough.
29th November, 1927. 7159

Egyptian State Railways,

TELEGRAPHS and TELEPHONES, REQUIRE the SERVICES of a SIGNAL INSPECTOR for the ENGINEERING DEPARTMENT at a salary of £E720 per annum, for a period of two years (£E1 equals £81 0s. 6d.).

QUALIFICATIONS REQUIRED :—

Specialised in Electro-pneumatic Signalling.

He would be required for the fitting in of the new installations of Electro-pneumatic Working of Points and Signals at Cairo Station, and it is absolutely essential that he has had actual practical experience in the following :—

Three-phase Electrical-driven Air Compressors (Alley and MacLellan type).
C Type Magnets for Point Operation.
Daylight Signals.
A.C. Track Circuits.
Illuminated Diagrams.
Electrical Detection of Points and Signals.
Relays.
Wiring Diagrams.
Fitting up the various types of Points Lay-outs.

If possible, the candidate should be a B.Sc. and an A.M.I.S.E.

Application form can be obtained from—

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street, London, S.W. 1.

Forms must be forwarded to him marked "SIGNAL INSPECTOR." 7179

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

J. & H. McLAREN, Ltd., Engineers, Leeds, Beg to THANK the APPLICANTS for the POST of ASSISTANT WORKS MANAGER, which has now been FILLED. 7177 A

WANTED, ENGINEER, Experienced in Erection of Reinforced Concrete Building Structures, who is a good organiser and has had charge of works of this character. State experience, age, and salary.—Address, 7168, The Engineer Office. 7168 A

WANTED, ENGINEER, to Assist in the Control and Management of a Large General Engineering Works in India. Must be of good education and with wide commercial and engineering experience. Age 30 to 35. Good salary and prospects to suitable man.—Address, sending full particulars, P3963, The Engineer Office. P3963 A

WANTED, from January, Capable ENGINEER to Take Charge of an Oxygen Plant.
Address—
P3976, The Engineer Office. P3976 A

SITUATIONS OPEN (continued)

ACCOUNTANT (Unmarried) WANTED, to Take Charge of Books of Builders and Contractors in Calcutta. Sound training in similar capacity essential. Passage paid. Agreement for four years. Salary Rs. 500, 550, 600, 650 per mensem.—Apply in writing, stating age, full particulars and copies of recent testimonials, to ANNAN DEXTER and CO., Chartered Accountants, 21, Ironmonger-lane, London, E.C. 2. 7203 A

ASSISTANT CIVIL ENGINEERS REQUIRED for important British-owned Railway in Argentina. Candidates to have had previous Railway experience on construction or maintenance and to have passed at least Parts "A" and "B" of Inst. C.E. exam. or hold exempting degree. Age 22-30. Three years' contract. Salary £450/550, plus £50 when knowledge of Spanish acquired.—Send full particulars education, training, experience, age, with copies (only) testimonials, to Box J. B. A., Davies, 95, Bishopsgate, London, E.C. 2. 7138 A

CHARGE HAND WANTED for Machine Shop Department of 15 to 20 hands in Engineering Works, North London. Energetic man with knowledge of modern methods essential.—Address, P3971, The Engineer Office. P3971 A

ENGINEER-SALESMAN REQUIRED, with Good knowledge of Reinforced Concrete Construction, for the Lancashire area. Only first-class men with sound experience need apply.—Address, 7176, The Engineer Office. 7176 A

MANAGER WANTED for Works Manufacturing Hot Yellow Metal Pressings; must be keen, energetic and a good disciplinarian; previous knowledge of the trade not essential, although desirable.—Address, stating age, experience and salary required, which will be treated in strict confidence, P3980, The Engineer Office. P3980 A

METALLURGIST, with Ironfoundry Experience, REQUIRED by North-East Coast Foundry specialising in high-class Marine, Loco., and General Castings, to Take Charge of Metallurgical Side. State age, full particulars experience, and salary.—Address, 7181, The Engineer Office. 7181 A

PLANT ENGINEER.—REQUIRED by Constructional and General Engineering Works on N.E. coast, ENGINEER to Supervise Construction of New Shops, Installation of Plant, &c.

Prospects of permanency for progressive practical man.

State age, experience, and salary required.—Address, 7114, The Engineer Office. 7114 A

RESIDENT ENGINEER REQUIRED by Firm of Specialists in Reinforced Concrete.—Address, stating age, experience, and salary required. 7178, The Engineer Office. 7178 A

REQUIRED by an Old-established Firm of General Engineers, a SALES ORGANISER and MANAGER. The position offered is a progressive one and only first-class men with engineering experience need apply. The firm specialises in Steam and Electrical Transport, Steam Engines and Power Plant.—Applications, stating full particulars of experience, age, and salary required, should be addressed to the CHAIRMAN, Richard Garrett and Sons, Ltd., Aldwych House, Aldwych, London, W.C. 2. 7189 A

SITUATIONS OPEN (continued)

SALESMAN, with Connection in Engineering Small Tools, to call on firms in London district. Experience, age, and salary required.—Address, P3965, The Engineer Office. P3965 A

TRAVELLERS WANTED IMMEDIATELY for Sale of monopoly line in provinces. Only live men with personality and address and with good connection among motor and engineering firms need apply. Salary £4 10s., travelling expenses and commission.—Apply by letter, giving age, full particulars of experience, districts covered, &c., Box 680, Willing's, 362, Gray's Inn-road, W.C. 1. 7202 A

WORKS MANAGER for Motor Sparking Plug Factory. Experience in this work essential. Good salary.—Address, P3964, The Engineer Office. P3964 A

WANTED, a First-class MARINE ENGINE DRAUGHTSMAN, with experience in Cargo Boat Pipe Arrangement Work.—Applicants to send copies of recent testimonials and state their age, experience, and salary required in confidence to the MANAGER, Central Marine Engine Works, West Hartlepool. 7195 A

WANTED AT ONCE, Experienced DRAUGHTSMAN for Air-cooled Aero-Engine Work. State fully experience, age and salary required and when free.—Address, P3977, The Engineer Office. P3977 A

WANTED, DRAUGHTSMAN, with First-class knowledge of Chemical and By-product Recovery Installations, also Gasworks Plant. State age and salary required.—Address, 7117, The Engineer Office. 7117 A

WANTED in the London District, a Capable DRAUGHTSMAN, having a sound knowledge of Steel Work for Building, Roofing, Bridges, &c. Give full experience, age, salary required, and when at liberty.—Address, P3973, The Engineer Office. P3973 A

CHIEF DRAUGHTSMAN WANTED for Large Iron and Steel Works.—Apply, stating age, experience, qualifications, and salary required, to BOLCKOW, VAUGHAN and CO., Ltd., Cleveland Steel Works, South Bank, Yorks. 7184 A

COMPETENT DRAUGHTSMAN REQUIRED, Experienced in Conveying and Elevating Machinery and Light Steel Structural Work.—Address, stating age, wage, and experience, 7127, The Engineer Office 7127 A

DRAUGHTSMAN, First-class Mechanical, Having sound experience of Linotype or Automatic Machine Design, together with Jig and Tool experience.—Address, giving particulars of age, experience, and salary required, 7183, The Engineer Office. 7183 A

MECHANICAL DRAUGHTSMAN, Having Thoroughly sound technical and practical knowledge and experience, REQUIRED for Colliery Work. Candidate with experience in manufacturers' works preferred.—Address, giving particulars of training, experience and age, and stating whether married or single, 7209, The Engineer Office. 7209 A

Write for Illustrated Price List dealing with Lorries ranging in carrying capacity from 3-12 tons, also special equipment such as Hand and Hydraulic Tipping Gears, Trailers, Creeper Track Vehicles, Petrol Rail Motors, Fire Engines, etc.

FOUR WHEEL DRIVE LORRY CO. LTD.

46, CHARING CROSS, LONDON, S.W. 1.

Phone—Gerrard 8058-9. 'Grams—Britfordri, Westrand, London.

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED for Industrial Hardening and Annealing Furnaces. State experience and wages required.—Address, 7210, The Engineer Office. 7210 A

MECHANICAL and GENERAL DRAUGHTSMAN REQUIRED, to prepare detail and scheme drawings for proposed new Plant and Buildings.

Candidates should be about 30 years of age, and the following training is essential :—

Sound technical training, diploma of one of the principal Engineering Colleges, 3 years' workshop experience with well-known firm of general engineers, 3 years' drawing-office experience, and some experience of estimating costs.

Applications will be considered only from first-class men with the above training and experience.

Address in the first instance for application forms, 7133, The Engineer Office. 7133 A

OLD-ESTABLISHED FIRM, Near Manchester, REQUIRE the SERVICES of a First-class DRAUGHTSMAN, thoroughly experienced in High-speed Steam Engine and Compressor Work; a knowledge of Solid Injection Oil Engines also an advantage. State age, salary, and when disengaged.—Address, 7211, The Engineer Office. 7211 A

SITUATIONS WANTED

CIVIL ENGINEER, with 20 Years' Experience, SEEKS TEMPORARY JOB for next few months. Has had charge of important works and survey work, but would take small job in England or on Continent temporarily. Fluent Spanish and Portuguese.—Address, P3962, The Engineer Office. P3962 B

ENGINEER, 1st Class Draughtsman and Translator (English, young); fluent technical French, 5 years' experience Continent, mechanical and structural engineering.—"B.," 2, Westgate-road, Beckenham. 7138 B

ENGINEER (35), Steam and Diesel (Continental trained), M.I. Mar. E., 1st Class B.O.T. Steam and Diesel Certificates, sailed chief engineer large motor vessel, good electrical and surveying experience, DESIRES RESPONSIBLE POSITION, home or abroad. Good references.—Address, P3966, The Engineer Office. P3966 B

ENGINEER, with EXCEPTIONAL EXPERIENCE, DESIRES CHANGE, GENERAL OR WORKS MANAGER; former chief draughtsman, expert production, foundry, UP TO DATE, technical, commercial, general engineering; young, able take sole control; energetic and trustworthy.—Address, P3981, The Engineer Office. P3981 B

ENGINEER (25½), Single, SEEKS POST, Home or abroad, on shift, maintenance or erection; 10 yrs. wide exp., inclu. 4 years' appren.; security if req.—Address, P3982, The Engineer Office. P3982 B

EX-CHIEF ENGINE-ROOM ARTIFICER, R.N., REQUIRES POST in Factory; pumping or power house fitter; excellent references. Further particulars.—Address, P3984, The Engineer Office. P3984 B

LIEUT.-COMDR. (E.), R.N. (Retired), Age 29, trained Osborne and Dartmouth Colleges and R.N. Engineering College, Keyham, Devonport, REQUIRES POST with Engineering Firm, London district.—LIEUT.-COMDR. SMITH, R.N., 25, Redcliffe-square, S.W. 10. P3986 B

MECHANICAL ENGINEER, Experience General power plant and machinery, holding First Class B.O.T. Certificates for steam and Diesel-engined vessels, experienced inspector boilers and machinery, and valuation, SEEKS BERTH at home or abroad, Charge Power Plant or other Post.—Address, P3967, The Engineer Office. P3967 B

YOUNG ENGINEER (22) DESIRES PROGRESSIVE SITUATION; good practical and theoretical training, locomotive and marine. Higher National Certificate of Institution of Mechanical Engineers; excellent references. Moderate salary.—Address, P3970, The Engineer Office. P3970 B

YOUNG ENGINEER (23), Stud. I. Mech. E., 9 Yrs. experience in ironfoundry making general engineers' castings, good practical knowledge of foundry practice, sand mixtures, cupola practice, &c., REQUIRES POSITION as ASSISTANT FOREMAN to Ironfoundry or similar progressive position.—Address, P3975, The Engineer Office. P3975 B

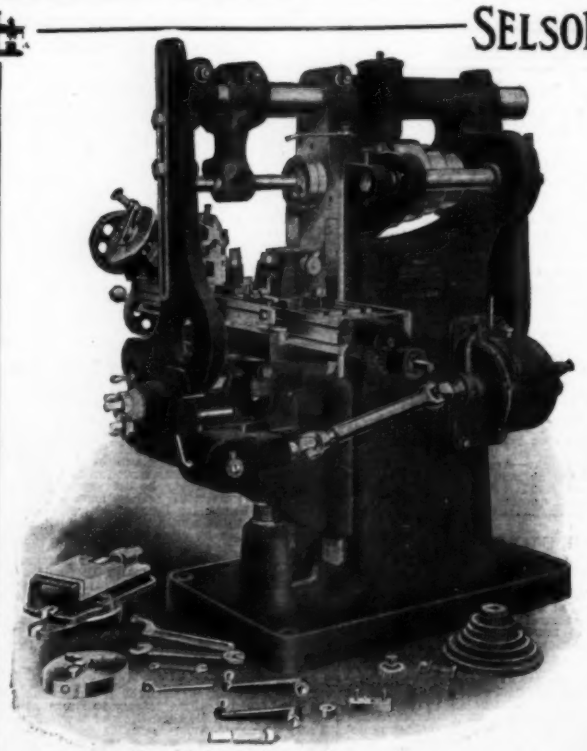
DRAUGHTSMAN, at Present Finishing His Time in Baghdad, would LIKE a POSITION in England, about April or May. Broad experience, age 22.—Address, P3969, The Engineer Office. P3969 B

DRAUGHTSMAN, General Engineering, Age 45 Yrs. Factory lay-outs, elevators and conveyors, chemical plant, rubber plant, light structural work. Disengaged.—Address, P3983, The Engineer Office. P3983 B

TO RAILWAY OR ELECTRICAL ENGINEERS.—First-class WORKING FOREMAN PAINTER. Small Writer, and Diagram Painter; first-class references if required; interview.—Write, F. BIRCH, 5, Station-street, Tewkesbury, Glos. P3979 B

For continuation of Small Advertisements see page 3.

SELSON



When buying a Milling Machine why not have the Best?

KEMPSMITH —MILLERS—

have a reputation and are always to the fore.

CONE PULLEY or SINGLE PULLEY DRIVE.

Stock Delivery.

Full particulars and prices on application.

SOLE AGENTS :—

ENG. **SELSON** Co., Ltd.,
26/28, CHARLES ST., HATTON GARDEN,
LONDON, E.C. 1.

A Seven-Day Journal

Research on Cast Iron.

AT the annual meeting of the Cast Iron Research Association, which took place in London last week, some disappointment was expressed by the chairman, Mr. H. B. Weeks, at the lack of support which was shown by many foundries in the work of the Association. Mr. Weeks said that while some of the withdrawals, especially of the smaller foundries, had no doubt their origin in the difficult times through which the industry had passed during the past year, the important work done by the Association certainly called for a further measure of industrial support. During the last six years no less than £40,000 to £50,000 pounds had been spent on research work, which was still very far from completion. It was pointed out that while there were some 2100 foundries in the country, only 299 were members of the Association, 226 being ordinary and trade members. In the annual report of the Association a full account of the progress of experiments during the year is given. That work includes tests on moulding sands, studies of the influences of aluminium, chromium and nickel on cast iron, and a new theory of the constitution of cast iron which has been elaborated by Dr. Hanson, of Birmingham. Thanks were accorded to Dr. Rosenhain and Professor T. Turner, the scientific advisers to the Association, and Major-General Sir Philip Nash was elected President in succession to Sir John Dewrance. An interesting statement which was made at the meeting had reference to the proposal to rent a small foundry near the headquarters of the Association in St. Paul's-square, Birmingham, so that experiments could be carried on under practical conditions, alongside the work which would continue to be done in the foundries of the members.

The Port of Liverpool.

ON Monday last the Gladstone Graving Dock at Liverpool, which, after being opened by the King in July, 1913, was again closed in March, 1921, to allow the full completion of the Gladstone Dock scheme, was reopened. A description of the dock and the pumping machinery was given in THE ENGINEER of July 22nd last, in which article reference to earlier descriptions was made. The first vessel to enter the dock was the 18,940-ton White Star Liner Albertic, which, after renovation, will be followed at intervals by the Adriatic, Megantic and Celtic, all of the White Star fleet. Another happening at the Port of Liverpool, which unfortunately has been attended with serious financial loss, was the stranding of the motor vessel Lochmonar, of the Royal Mail Steam Packet Company, which, when entering port in the early morning hours of Wednesday of last week, went aground on the revetment, to the north of the Crosby Lightship. The Lochmonar was returning from Vancouver with passengers and a cargo of dried fruits. Happily both the passengers and cargo were transhipped and landed without difficulty. It is understood that the steering gear of the ship was found to be out of action, which, if confirmed, will account for the mishap. Efforts to refloat the vessel failed, and on Monday last she broke her back with the ebbing tide. A temporary bulkhead has been built to fill the open space at the after part of the vessel, and it is hoped to salve that part of the ship by refloating it and towing it into dry dock. The Lochmonar was a 485ft. vessel of about 9400 gross tons, and was propelled by twin-screw four-cycle single-acting oil engines, designed to develop about 4500 shaft horsepower. She was built and engined by Harland and Wolff in 1924.

The Late Mr. C. F. Torrey.

IT is with regret that we learn of the death of Mr. Charles Franklin Torrey, the chairman of the Atlantic Transport Company, Ltd., and Frederick Leyland and Co., Ltd. Mr. Torrey, who died at his London home in Victoria-street, on Monday last, was only ill a few days, and had he lived he would have been seventy years old next January. He was a founder of the firm Williams, Torrey and Field, out of which the Atlantic Transport Line was subsequently formed, and was connected with the development of his company's undertaking over an unbroken period of more than forty years. Through the late Mr. J. Pierpont Morgan, the International Mercantile Marine Company of New Jersey acquired a financial interest in the Atlantic Transport Company, Ltd., thereby bringing Mr. Torrey into close touch with American shipping circles. Indeed, he came to be looked upon as one of the chief authorities on the North Atlantic shipping trade. Despite its American interest, the Atlantic Transport Company, Ltd., continued to be a British undertaking, and its ships sailed under the British flag. Since 1909 Mr. Torrey had been an active member of the Port of London Authority, and was recently chairman of the Port and Warehouses Committee. The post-war shipbuilding programme, which was so successfully carried out by his company has materially aided the development of the port. Besides being a Committee member of Lloyd's Register of Shipping, Mr. Torrey held other directorships on shipping bodies. In his many-sided activities he was held in the highest regard by a wide circle of personal and business friends on both sides of the Atlantic. He will be long remembered for his singular personal charm and great courtesy, and we may rejoice that as one who enjoyed his work he was able to carry on his duties until within a few days of his death.

The London Terminal Air Port.

AN important step in the plans for improving London's Terminal Air Port at Croydon, will be taken to-day, when Sir Samuel Hoare, the Secretary of State for Air, will formally declare open a new road, which has been constructed around the south-western corner of the aerodrome. The new road will enable the Air Port Authorities to close from to-morrow onwards the through road known as Plough-lane, which now bisects the aerodrome. Work is to be begun almost immediately on the demolition of the existing war-time buildings and houses, near the centre of the aerodrome, and the levelling out of the site on which they now stand. When completed an unrestricted run will be obtained over the full stretch of ground for the landing and taking off of aeroplanes. Already marked progress has been made towards the completion of a well-planned group of reception buildings, administrative offices, workshops and hangars, all of which have been constructed in ferro-crete near the north north-eastern corner of the aerodrome at Waddon. The new buildings are surmounted by a central tower some 50ft. in height. Some of the new hangars are now being used and more will be occupied as the present central hangars are vacated. The final removal from the old buildings will take place early in January, and with the New Year notable improvements will have been made. It is anticipated that the work on the rearrangement of the aerodrome and the new administration buildings will be completed about April next.

The Decimal Association.

AT the annual general meeting of the Decimal Association, held in London on Monday of this week, Sir Richard Gregory resigned the Presidency after a five-year term of office to Sir Hugo Hirst, of the General Electric Company. It is thirty years since the use of metric weights and measures for the general purposes of trade was made lawful in this country. The trading community as a whole have not, however, in Sir Richard's words, manifested any eagerness to take advantage of this permissive legislation. Sir Richard claimed that the importance of the universal adoption of the metric system was every year becoming more fully recognised in British Dominions, Colonies and Dependencies, because of the difficulties experienced in commerce with foreign countries. It was scarcely practicable, he said, for any part of the Empire to insist upon the compulsory use of the metric system in general trade until the system was made compulsory in Great Britain. We and the United States stood apart in this matter from practically all the other countries of the world, and declined to enter into what was an international commonwealth of commerce. Sir Hugo Hirst said that in his own business he had found the metric system very useful in the development of export trade, and urged that the present was a suitable time for reviving the demand for the decimal system. The electrical industry is fortunate in being founded on the metric system, and in it, if anywhere, we might expect to find little opposition to a general change to that system. Other branches of engineering are much less fortunately situated. From their point of view, struggling as they are for a bare existence, there could hardly be a moment more inappropriate than the present to suggest a change that would involve them in a very large expenditure and a very considerable upset to established customs.

Warship Reconstruction.

THE modernisation of our battle fleet is making good progress. Since new construction is rigidly limited by the Washington Treaty, it is indispensable that such capital ships as we possess should be maintained at full efficiency. This policy necessitates thoroughgoing and expensive refits, and the total cost of renovating our pre-Treaty battleships will fall not far short of the price of a new ship. The latest vessel to undergo a big refit is the battleship Resolution, which is to commission on December 30th for service in the Mediterranean. The work done on this ship during her sojourn in Portsmouth Dockyard, which included the re-tubing of her boilers, has cost £276,591. The renovation of the "Queen Elizabeth" class is proving much more expensive, owing to the drastic alterations that are being made. The changes include the fitting of bulges and a new arrangement of boiler uptakes and casings. The Warspite and the Queen Elizabeth have been completed, each at a cost of about £620,000—roughly, one-fifth of the original cost of each ship—and the three remaining units of the class are to be dealt with as circumstances permit. When they are again in service we shall have thirteen capital ships equipped with bulges. The two "Nelsons" have a special system of underwater protection, while it is apparently not intended to "bulge" the four "Iron Dukes" and the Tiger, as they will become due for scrapping a few years hence. The heaviest expenditure for reconstruction is entailed in the case of the Courageous and Glorious, which are being rebuilt as aircraft carriers. The estimated cost of work on the first-named ship alone is £2,025,000. To reconstruct the Centurion as a fleet target ship has cost £358,000. Other vessels undergoing large repairs are four light cruisers, two sloops and a repair ship, the total outlay on them being estimated at £642,883.

A Noteworthy Bridge Reconstruction.

A NOTEWORTHY bridge reconstruction feat has just been completed on the London and North-Eastern main line from King's Cross to the North. The old bridge over the Great North Road at Grantham was considered inadequate to support the increased weight of traffic, and it was decided to replace it by a single span steel bridge, composed of a heavy built-up trough girder and two parapet girders. The work entailed the supply of 90 tons of steelwork, 500 cubic yards of creosoted timber, and 260 cubic yards of rock asphalt. The bridge was constructed and erected by John Butler and Co., Ltd., of Leeds, to the design of Mr. C. J. Brown, the railway company's chief engineer, and under the supervision of Mr. A. J. Grinling, the railway company's district engineer at Peterborough. The order to proceed with the work was received on October 20th, 1927. On Sunday, November 27th, five weeks after the receipt of the order to proceed, the first half of the old bridge was removed and the first half of the new bridge erected in its place. The second half of the work was begun and completed last Sunday, December 4th. During each of the two days' operations some 40 tons of old cast iron girders and a considerable amount of brickwork in jack arches had to be removed before the new girders could be fixed in position. The new steel work was lifted into position by means of a 35-ton and a 45-ton railway crane, obtained from Peterborough and Doncaster. Not only was the bridge manufactured and erected within six weeks of the order being received, but on both erection days the line was opened for traffic before the time scheduled by the railway engineers. On the second day the bridge was open to traffic three hours ten minutes before the scheduled time, and the afternoon expresses in both directions were able to travel on the correct track on the up and down lines.

Steam *versus* Electric Traction.

THE recent announcement that the Austrian Federal State Railways had decided to abandon the proposal to electrify the main line from Vienna to Salzburg has now been supplemented by some interesting facts concerning the relative cost of electric and steam operation in that country. A detailed calculation has apparently shown that electric haulage on the Vienna–Salzburg line would cost 9,000,000 Austrian shillings, or £260,000, more per year than steam traction. In 1920 leading Austrian economists and industrialists came to the conclusion that electric operation would result in cheaper transport, but since that time the price of coal has been reduced. In 1922 coal suitable for railway purposes cost 80 Austrian shillings, or £2 6s., per ton. To-day, however, the same coal can be purchased for about 30 Austrian shillings, or 19 English shillings, and this reduction in cost, coupled with the fact that the fuel consumption of the steam locomotives has been improved, has placed electric traction in a rather unfavourable position. The coal bill of the Austrian railways was twice as high in 1923 as it has been during the present year, and at the same time the cost of hydro-electric power has increased. In 1920 and in the following year Austrian currency was steadily falling, and during this inflation period it was possible to erect power stations at comparatively small cost, but credit conditions at present make the erection of such stations expensive, and, all things considered, railway electrification, it is held, does not pay.

Thames Bridges.

IT would appear that some months more must elapse before the report on the proposed Charing Cross road and railway bridge is ready for submission. The construction of the bridge was recommended by the Royal Commission on Cross River Traffic, and it was estimated that the scheme would involve an expenditure of between twelve and thirteen million pounds. An inquiry into the proposal was ordered, and was placed in the hands of Messrs Mott, Hay and Anderson, consulting engineers, in conjunction with Sir George Humphreys, the chief engineer to the London County Council, and Mr. A. W. Szlumper, late chief engineer to the Southern Railway. It is stated on apparently good authority that this Committee will not be in a position to submit a report on the scheme until the spring. It is very unlikely that the London County Council will come to any decision regarding the course to be pursued in connection with the reconstruction or demolition of Waterloo Bridge until the report on the proposed Charing Cross Bridge has been received and fully considered.

The Shannon Power Scheme.

No. II.*

Local Transportation.

Soon after the contract for the Shannon power scheme was signed in August, 1925, preparations were made at Limerick harbour for unloading the ships bringing the large amount of necessary plant from Germany. Many heavy machines and parts of machines had to be conveyed from the harbour to the building sites, including no fewer than seventy-six locomotives, and two movable oil engine cranes and an electric derrick crane were erected for dealing with them. Special trailers hauled by Daimler tractors were brought into use for conveying the locomotives from the harbour to the tracks and for moving them from one track to another. The same method of transport was adopted for moving heavy excavator parts and motor boats employed on the Shannon and Lough Derg. For the movement of material at site over 100 kiloms. —62 miles—of railway track have been laid. For the most part the locomotives that run on the tracks along the banks of the head-race and elsewhere are worked by steam, but on sections that will not have to be shifted during the whole of the building period, electric locomotives are employed. Thirteen Mannesmann-Mulag tractors are now available for transport work between the harbour and the building sites, and for the other transport work that cannot be carried out by rail. Motor boats and tugs convey material and plant from one bank of the Shannon to the other and across Lough Derg, to the Portumna-Banagher building site. One of the tugs is driven by a 200 horse-power Diesel engine, and some idea of its capabilities can be gained from the fact that it has towed two barges carrying a bucket dredger weighing 35 tons over Lough Derg. Coal and other fuel for the building sites is delivered to the points where it is needed by a temporary railway.

The Stores.

Ardnacrusha, which less than three years ago was a quiet country spot, has been turned into a place of great activity. For many years past it had been recognised that if the Shannon was to be harnessed for electric power purposes, Ardnacrusha, 3 miles due north of Limerick, ought to be the site for the power station, because it is admirably situated for the purpose of concentrating the fall between the intake above O'Briens Bridge and the tail-race outlet at Parteen. Anyone familiar with Ardnacrusha before the Shannon power scheme was begun would scarcely recognise it to-day, for apart from the constructional work that is being carried out there, various buildings have been erected with a view to centralising the supplies for the building sites and to supplying electric power economically and conveniently to the various workshops, &c., from the temporary power station that has been established at this spot. A view of some of these buildings at Ardnacrusha is given in Fig. 20, on page 658. Among many other things stored at Ardnacrusha is oil, and in order to ensure that the correct kind of oil may be employed for use in all cases, a somewhat elaborate storing and measuring plant has been installed. Owing to the fact that all the machinery used for the civil engineering work was sent over from Germany, and that to obtain spare parts from that country would cause considerable delay, a large stock of parts for all the machines is maintained. With the exception of timber, all the material is delivered ready for use and is distributed to the building sites by means of the transport railway. The timber, on the other hand, is prepared on the site by means of an electrically driven saw and other wood-working machines, erected in a suitable building at Ardnacrusha. It is noteworthy that coal and cement are being purchased from this country.

Repair Shops and Power Station.

Needless to say, in connection with an undertaking of this nature a great deal of repair work has to be undertaken, and the engineering repair shop, at Ardnacrusha, of which we give a view in Fig. 11, is a very busy place, which is equipped with all

FIG. 15—STONE-CRUSHING AND WASHING PLANT NEAR ARDNACRUSHA

FIG. 11—GENERAL REPAIR SHOP

FIG. 12—WOODWORKING SHOP

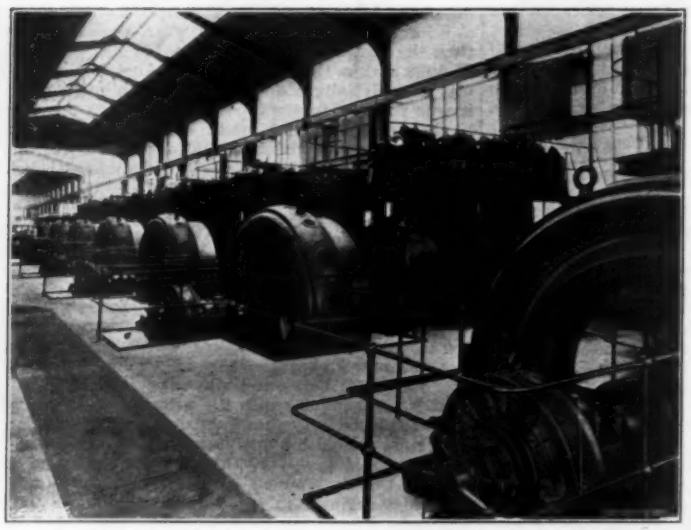


FIG. 13—TEMPORARY POWER STATION

FIG. 14—TEMPORARY POWER STATION SWITCHBOARD

* No. I. appeared December 2nd.

the necessary machine tools. There are also a smithy, a joiners' department—see Fig. 12—a tool-making department and a welding department, the complete works giving employment to 170 men. Near to this extensive and busy repair shop is an electrically-driven plant which provides oxygen for welding and cutting steel. Electric welding is only employed to a limited extent. The power station that has been erected at Ardnacrusha—see Fig. 13—is more like a permanent station than a temporary one. Realising the importance of a constant electricity supply, the engineers decided to make a thoroughly good job of the power-house. The engines, the switchgear—see Fig. 14—and the building itself all give one the impression that they have been laid down to serve for many years to come. Nothing suggests that the station is only of a temporary nature. There are nine Diesel engines, with a total output of 4180 horse-power, and the plant works with a load factor of about 70 per cent. The station is run on precisely the same lines as a public supply station. Load curves are plotted and careful attention is paid to the working costs. Each engine is directly coupled to a three-phase alternator working at a pressure of 400 volts, which, in spite of the variable nature of the load, remains remarkably steady. On the building works outside various pressures are used. There is a 17,000-volt line running to the Weir, and 3000 and 380-volt supplies are also available. In many cases current is supplied to the stators of induction motors—which are mainly of the slip-ring type—at a pressure of 3000 volts. Owing to the large number of motors used, the power factor is only about 0·5, but as the alternators are designed for operating at a low power factor, the engines can be fully loaded.

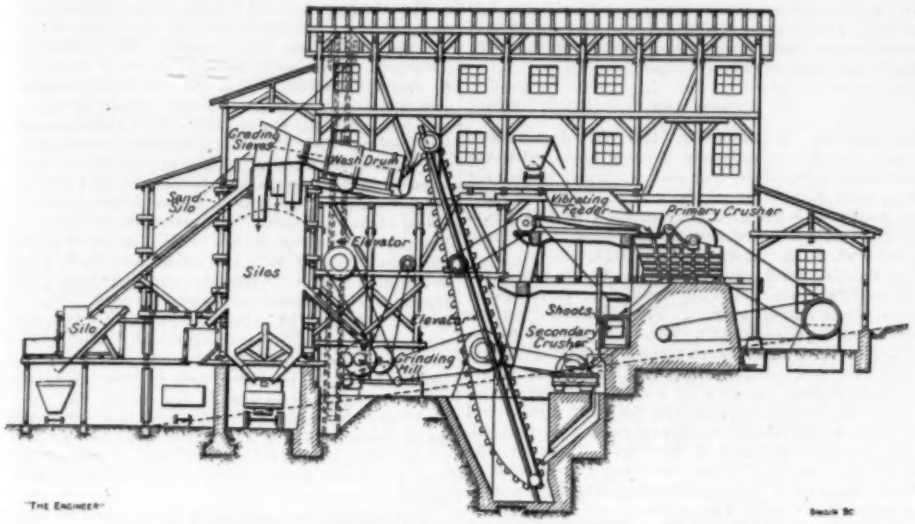


FIG. 16—SECTIONAL ELEVATION OF STONE-CRUSHING AND WASHING PLANT

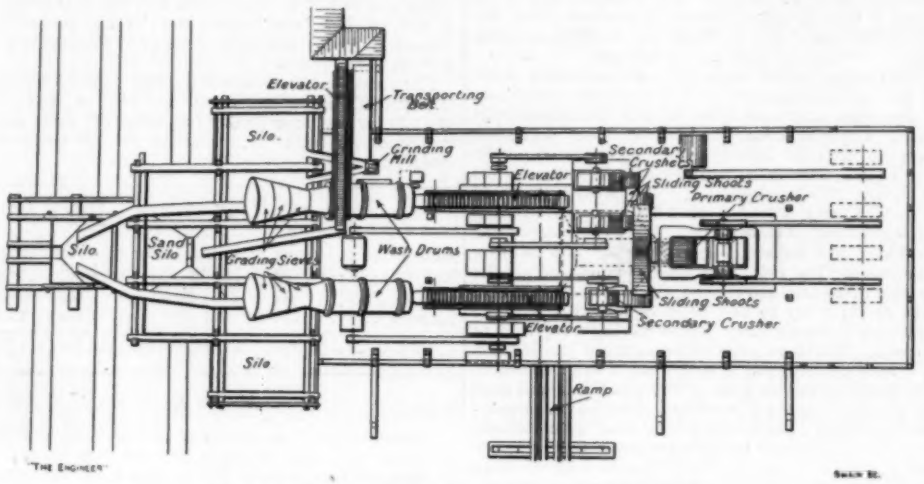


FIG. 17—PLAN OF STONE-CRUSHING AND WASHING PLANT

THE CAMPS.

At the most important centres, namely, Ardnacrusha, Clonlara at the Weir, and O'Briens Bridge, camps—see Figs. 21 and 23 on page 658—have been provided for the workmen. The Ardnacrusha camp is by far the largest, and it has picturesque surroundings. There is an Irish and German section. The former, which accommodates 750 men, consists of seven large and four small huts, a building containing baths, a large recreation ground, a dining room capable of seating 600 people, a kitchen with a canteen and a provision shop. The large huts are built of concrete, whilst the smaller huts are made of wood. Most of the large huts have three rooms, each of which can accommodate thirty men, but one of these huts, which is set aside for skilled workmen, is divided into six small flats. Hot and cold water is available in the bath house. All the buildings are fitted with electric light, and in the winter they are heated by large stoves. Every consideration is paid to the health and general welfare of the workmen. An Irish commandant controls the Irish camp and an Irish doctor, employed by the contractors, devotes his whole time to the men, who are thoroughly overhauled on arrival and attended to in the case of illness or accident. The doctor also sees that good and wholesome food is provided at the canteens. Special attention has been paid to the sanitary arrangements at the camps with a view to avoiding the outbreak of disease. Entertainments in the form of cinema performances, concerts, &c., are provided, especially during the week-ends. There are also facilities for playing table games, and a camp library is at the disposal of the workers, whilst some little distance from the camp there is a football ground. The German camp, which is situated about 150 yards away from the Irish camp, is similar to the latter, and consists of huts built of timber and concrete. Many of the Germans engaged on the work have brought their families to live with them, and some quite decent-looking houses—see Fig. 22 on page 658—have been built for the married German employees. For the benefit of the German children, which number about forty, a German school teacher is employed, and the children receive instruction in a school building in close proximity to the camp. The camps at Clonlara and at the Weir are arranged on lines similar to those described, but they are on a smaller scale than those at Ardnacrusha. An old disused mill has been brought into service at O'Brien's Bridge, and has been provided with central heating.

STONE-CRUSHING PLANT.

Near Ardnacrusha there is one of the stone-crushing and washing plants, which is the principal plant of its kind associated with the building operations. A large part of the limestone that is won by excavating the head and tail-races and the power station site is used for the building work. As this material is of good quality and does not contain anything that is harmful, it can be safely used for concrete, road metal, railway ballast and rip-rap for dressing the sides of the head-race. For the latter purpose about 348,000 cubic metres (say, 12,300,000 cubic feet) will be needed, whilst for roads and railway tracks and other purposes, approximately 45,000 cubic metres (say, 1,589,246 cubic feet) of broken stone will be required. The rock is crushed into sand, aggregate and rip-rap in two large stone-crushing and washing plants close to the rock sections, which are situated on the upper part of the tail-race and near Clonlara. In each case the machinery belonging to these stone-crushing and washing plants is concentrated in a single building, and the silos which receive the broken stone and sand are directly attached to the building. From the moment the material leaves the trucks until it reaches the silos it is dealt with automatically. Drawings of the principal stone-crushing plant at Ardnacrusha are given in Figs. 16 and 17, whilst Fig. 15 gives an exterior view of the building and the trucks which convey the broken rock up the ramp to the crusher. A view of the preliminary crusher is given in Fig. 18, and a view of the washing machines in Fig. 19. Having been filled, the trucks are drawn by a winch up the incline supported on wooden trestles on to the upper floor of the building, where a workman opens the side of the truck, and the material drops on to a

FIG. 18—PRELIMINARY STONE CRUSHER

FIG. 19—STONE-WASHING PLANT

large receptacle with a movable bottom. From this receptacle the rock passes into the large crusher, which has an aperture of 1200 mm. by 900 mm. (say 48in. by 36in.), and which can easily crush blocks of rock of ¾ cubic metre—say, 26 cubic feet—content. As the plant can crush the rock in the state it is in after blasting operations, and as loaded by steam shovels into the trucks, the expensive operation of breaking up the rock by hand or by additional blasting is avoided. The main or preliminary crusher breaks the rock into pieces not larger than 3 cubic decimetres (183 cubic inches). The material is then conveyed on bands through three other crushers, two having apertures of 650 mm. by 300 mm.—say, 26in. by 12in.—and the third an aperture of 750 mm. by 400 mm.—say, 30in. by 16in. These crushers reduce the material to rip-rap, coarse, and fine aggregate, and sand. Two belts convey the material up to two washing machines above the silos, where it is finally cleansed. The washing drums are furnished with perforated screws which convey the stones through the flowing water, with the result that all the earth is removed. The sand, aggregate and rip-rap are thoroughly cleaned by being continuously shaken whilst water is being poured over them. Perforated drums attached to the washing plant divide the material into sand, fine, and coarse aggregate. The larger-sized material which is rejected, and which can be used for the slopes of the head-race, for road metal and railway ballast, falls directly into the trucks of the transport railway, and a small intermediary silo makes it possible to dump the material during the time the trucks have to be moved. The silos for sand and fine and coarse aggregate are built so that the material can be emptied into the trucks of the train or into lorries, so that it is possible to supply the most distant sites with sand aggregate and road metal. A 15-ton travelling crane has been erected alongside the crushing plant building to facilitate repairs to the machinery. The stone-crushing and washing plant near Ardnacrusha is capable of dealing with from 40 to 50 cubic metres (say, 1412 to 1765 cubic feet) of sand, aggregate and rip-rap per hour. The plant at Clonlara is on a somewhat smaller scale, but it works on the same principle as the plant at Ardnacrusha. All the machinery associated with the two crushing plants is driven by induction motors.

(To be continued.)

Recent Progress in the Methods of City Refuse Collection and Disposal.

By JOHN B. C. KERSHAW, F.I.C.

No. I.

THE issue of THE ENGINEER for October 13th, 1916, contained an article by the present writer upon the subject of the utilisation of town's refuse and garbage, and the present article is designed to bring the information given in that earlier article up to date. The writer prophesied eleven years ago that the method of charging all refuse into destructors without any attempt to recover the more valuable materials would be modified, and the developments which have occurred in the period since that article was written have proved the correctness of that forecast. All the recently erected plants have elaborate arrangements for the sorting of the refuse as it is brought to the works, and a considerable revenue is obtained by the salvage and sale of the metals, paper, glass, &c., separated from it before it is discharged into the destructor furnaces. The heat which is developed in these furnaces is employed in waste heat boilers for generating steam, which is now either sold to some neighbouring works that can make use of it or is employed for running the machinery required to operate the destructor and its subsidiary plant. Owing to the rise in the cost of labour, all the work of these modern destructor plants, so far as possible, is carried on by mechanical power, and a large number of electric motors are employed in running the machinery.

The design and operation of these plants demands more power than formerly, and it is now customary to find them equipped with their own central generating stations, run by the steam power obtained by the hot gases coming from the destructor furnaces. Their design and operation offers therefore much more scope for the skilled engineer than eleven years ago. Considerable changes have occurred also in the method of collecting the refuse. At Southport a method has been adopted which combines the advantages of the old horse and cart system with those offered by the quickly moving petrol wagon, and the writer believes that if the Southport system of collection is found economical it will be adopted gradually in other districts of a similar character. The new system confines the petrol motor wagon to its proper function of rapid transit, and employs horse traction for the actual collection of the refuse which involves a large number of stoppages at short intervals of time.

The disposal and treatment of city and urban wastes is, therefore, well worth the study of engineers, and the descriptions given below relating to the latest destructor plants show that very large sums of money have been expended upon their equipment. The writer believes that their number will increase rapidly during the next ten years, and that the health authorities of some of the larger colonial and foreign cities will follow the lead given by British municipalities in the methods employed for dealing with domestic and trade refuse. It is to be hoped that some of these orders will be placed in this country with the English firms which have been the pioneers in the design and construction of destructor furnaces and of the subsidiary plant and machinery.

BIRMINGHAM.

Birmingham possesses in the Brookvale-road, Tyseley and Montague-street salvage and destructor works three up-to-date and well-equipped plants for dealing with the refuse of the city. The Brookvale-road works was planned and erected in the years 1922–24, and a full description appeared in the issue of THE ENGINEER for April 18th, 1924.

The Tyseley works was erected and completed two years later, and the following description of the plant is drawn from official sources. The refuse as it arrives at the depôt is passed over a 20-ton weighing machine, and is then discharged upon a tipping platform, formed by the flat roof over the garages, screening plants and destructors. In case of emergency the refuse can be tipped directly into the hoppers which feed the furnaces, and the screening process can be omitted. In the ordinary method of treatment, however, the refuse is first passed through revolving screens erected in two independent units, and designed to take out all dust below ¾in. mesh. This is estimated to amount to 40 per cent. of the ordinary refuse. The hoppers which feed the screening plant have each a capacity of 15 tons, and are fitted with Heenan and Froude's patented device for regulating the feed of refuse to the screening plant. The dust which passes through the screens is then carried by a belt conveyor to an aerial ropeway, by which it is transported over a considerable distance to the tip. This method of disposal would hardly seem to be the most profitable for this fine dust, since at Glasgow and Sheffield and other places a considerable revenue is derived from the sale of this material as a prepared or artificial manure, after its treatment with liquid sewage.

The tailings which come from the screening plant are first passed through or over magnetic separators of the type first employed at the Brookvale-road works. These separators recover the "tin" and other magnetic material before the tailings pass on to the sorting belts, where the glass and other larger materials are removed by hand picking. The paper is removed by suction, and is transported by pneumatic means to the basement of the building, where it is compressed into bales in a suitable form of press. The tailings, after leaving the belt, and after removal of all the salvable materials, are carried by a specially designed plate elevator up to the hoppers placed above the destructor furnaces, each hopper having a capacity of 100 tons. The destructor furnaces are of the Heenan type, and are arranged in two units of four cells each, each grate having an area of 36 square feet and each unit having a capacity of 60 tons of refuse per twenty-four-hour day. Each cell is provided with its own charging hopper, which is filled with refuse before the charging door is opened, and the bottom of each hopper is made to slide in conjunction with the opening of the furnace doors. This method of charging reduces the amount of cold air admitted to the furnaces and increases their efficiency. The heat produced by the combustion of the refuse is utilised in two Lancashire boilers producing 8000 lb. of steam per hour at 160 lb. pressure, and at a temperature of 500 deg. Fah.

The plant for dealing with the clinker produced by the furnaces is situated a short distance from the main buildings, and forms a self-contained unit, a small electric tractor being used for transport of the clinker trucks between the two plants. The crusher is of the double-roll type, and is driven through belts from a standard motor situated above the pit. Means are provided for varying the size of the product, whilst a safety device obviates damage to the crushing rolls by very hard material. The crushed clinker is elevated by a chain and bucket elevator to the screens, which are placed in the upper portion of the building. A magnetic separator at this points separates any material, such as nails, &c., which have been missed in the original screening of the refuse. The screen itself is 4ft. diameter by 18ft. long, and by it the crushed clinker is graded into several sizes, and is stored in separate compartments of the crushed clinker hopper, which has a total capacity of 75 tons.

The generating plant consists of two high-speed condensing engines, direct coupled to continuous-current generators, each of 100 kW capacity. The standard motors used in running the conveyors and other machinery are of the shunt-wound interpole type, and are capable of developing 15 B.H.P. The subsidiary plant consists of an exhaust fan which collects the waste paper from the ends of the conveying belts and carries it to the baling press, and a cyclone separator which releases the air from the other materials and collects the light dust in sacks, while the paper and other similar light wastes are deposited on the floor adjacent to the baling presses. The tin presses are cylindrical in shape, and can reduce 20 cubic feet of tin to 2 cubic feet, and exert a total pressure of 50 tons. The hydraulic power is supplied by means of two pumps worked in conjunction with an accumulator and intensifier. The tins before compression are de-tinned in a furnace heated by gases taken from the combustion chamber of the destructor, and dampers are provided by which the temperature can be regulated.

The Montague-street works is an old one that has recently been extended and provided with more up-to-date equipment for treatment of organic waste materials. The plant now consists of nine melters or driers, four centrifugal fat extractors driven by steam turbines, and the necessary tanks for clarifying and purifying the melted fat. The works is designed for dealing with 4000 tons of slaughter-house and fish-refuse per annum, and is producing about 1000 tons of feeding meals and fertilisers, and 80 tons of fat per annum; the value of this recovered material being about £10,000. The materials brought to the Montague-street works are classed in three grades as condemned meat, fish and offal, and each grade of material is treated separately, since the time required for extracting the fat varies in each case. The refuse is first prepared by passing through a crusher (or a meat-cutter) which is mechanically operated, and it is then discharged into melters, which are steam-jacketed vessels, provided with mechanical agitators. After charging these vessels are closed, and the contents are subjected to heat treatment by steam at 80 lb. pressure for a period varying from two to six hours. The charge is then withdrawn, and all the fat that is in the liquid state is allowed to run to the collecting vats.

The residue of solid material is transferred while still hot to the fat extractors, which are perforated steel baskets, operated on the steam-turbine principle at a speed of 800 r.p.m. The fats contained in, or clinging to, the solid refuse, are thus thrown out by centrifugal force. The amount which is left can be varied to suit the purpose for which the material is to be applied; but the whole of it is passed through a disintegrator which reduces it to a fine powder before it is sold. The transport of the material from the fat extractors to the disintegrators, and the final bagging of the product, are carried out on the pneumatic system, and only one man is required to operate this portion of the plant.

The gross annual income of the Birmingham Salvage Department increased from £19,408 in 1922 to £25,223 for the year 1926. The following table gives the amounts received for some of the recovered materials:—

	1922.	1923.	1924.	1925.	1926.
	£	£	£	£	£
Manure	3,493	4,848	5,925	6,545	8,067
Grease	520	489	1,828	1,816	1,305
Clinker	2,806	3,597	6,164	9,139	11,068
Scrap metals ..	291	2,217	2,568	3,488	2,664
Sundries	554	487	712	1,456	2,119
Totals ..	£7,664	£11,638	£17,197	£22,444	£25,223

GLASGOW.

The refuse wagons on arrival at the Glasgow works pass over the weigh-bridges, and are then hauled up an inclined roadquay to the tipping floor, where the refuse is raked out into a chute. This chute leads into the inlet end of a cone-shaped screen revolving at about 12 r.p.m. The screen is provided at each end with rolled steel tires 8ft. in diameter, rotating on cast steel bearing wheels. The drive is by rack and pinion, and the screen meshes have a width of opening of 1¼in. The effective length of the screen is 9½ft., and the total superficial open area of the meshes is 90 square feet. The maximum amount of refuse which can be dealt with per hour is 15 tons, equivalent to 120 tons per eight-hour working day.

The material under 1¼in. which passes through the screen forms 80 to 85 per cent. of the domestic refuse, and drops into a mixing machine underneath, which also receive a quantity of sewage matter from a tank placed above. Dry sweepings from paved streets are also passed through the screen into the mixer. The whole, after being thoroughly incorporated by means of revolving blades, is discharged into a railway wagon on the siding below, and the "compost" is either despatched to farmers as "prepared city manure," or is carried by rail to the Cleansing Department's tips in the country.

The rougher portion of the refuse, which cannot pass through the screen, is delivered from its bell-shaped mouth on to an endless belt. When passing over this conveyor, articles of any value, such as iron, meat tins, fruit tins, bones, &c., are picked off for disposal as marketable commodities—while the remainder, chiefly light useless material, falls from the conveyor into a range of destructor furnaces on a lower level. These are of the top-feed, hand-fired type, and the burnt material or "clinker," from these furnaces is fed into a breaker. The broken pieces are elevated by means of a bucket elevator to four perforated cylindrical revolving screens, where the material is graded into four sizes (¼in., ½in., ¾in., 1in.) and tailings. The material finds a ready sale for the making of concrete, &c. Prior fo 1896 it was carried across to tips at a cost of 1s. per ton, but now instead of costing anything for its disposal, a good revenue is derived from it. The waste tins are detinned by heating to the melting point of the solder and tin in

a small furnace, and are then compressed by hydraulic power into 1 cwt. billets and sold as scrap iron.

	1923–24.	Per ton.	1924–25.	Per ton.
Total tonnage	358,433	—	347,180	—
Total expenditure	£52,889	2s. 11¼d.	£51,022	2s. 11¼d.
Income from salved materials	£15,419*	0s. 10½d.	£13,809*	0s. 9½d.
Net costs	£37,470	2s. 1½d.	£37,212	2s. 1½d.

* These totals include stable and slaughter-house manure—not scheduled as "prepared manure," also trade refuse.

Value of Materials Recovered.

	1923–24.	1924–25.	1925–26.
	£	£	£
Prepared manure	3,219	2,818	3,631
Waste paper	737	416	506
Oil tins, galvanised iron, scrap iron, &c.	3,405	3,609	2,527
Clinker	1,423	1,280	1,022
Miscellaneous	68	68	33
	£8,852	£8,191	£7,719

It is interesting to note that this Glasgow system of screening the City refuse and converting the finer portions into "prepared" manure has been in use in Glasgow for forty years, and that the revenue derived from this source during the past four decades has reached the remarkable total of over a quarter million pounds sterling. The method of salving all other saleable materials from the refuse has been in operation for fully twenty years, and has yielded a revenue of over £132,000, or a grand total of £400,000 since the respective schemes were introduced.

In this connection some experiments carried out recently by J. Bodler, and reported in the German paper *Gesundheit Ing.*, Vol. 46, may be referred to. Comparisons were instituted between the fertilising value of the fine waste from town salvage plants when mixed with sludge, and mixtures of ammonia sulphate, super-phosphates, and potassium chloride. More favourable results were obtained with the sifted garbage and sewage sludge than with the commercial fertilisers. On the subject of methods of refuse collection, the following extract from the 1924–25 report of the Glasgow Cleansing Superintendent may be quoted here:—"Within the experience of this department petrol vehicles have not proved suitable for the work of refuse collection, the cost being considerably higher than that of either horse or electric vehicles. Electric traction, while costing more than horse haulage within a radius of 1¾ miles, has given satisfactory results, having been found more reliable and more economical than petrol motors. At present the electrics require a "loader and packer," in addition to the driver, which method adds considerably to the cost; for in the case of the horse-vehicles, the driver assists in the work of loading and packing the wagons."

This is another point in favour of the Southport system.

HALIFAX.

A new system of refuse destruction has been introduced in the County Borough of Halifax, based upon the gasification of the material in a Wells type of refuse gas producer. The refuse is first screened to remove the dust, and is then charged into the producer. The gas obtained, after washing in cascade towers and passing through dry scrubbers, is burned under boilers, and the steam is employed to generate electric current. Preliminary tests have shown that 47,000 cubic feet of gas, with an average value of 130 B.Th.U. per cubic foot, can be produced per ton of screened refuse. As Halifax produces 22,000 tons of refuse annually, a very large amount of power would appear to be available from this source. The dust obtained by screening is mixed with the contents of pail-closets, and is enriched with the white ash from the producers, which is stated to contain considerable amounts of potash. The compounded fertiliser is then disposed of, as at Glasgow and Sheffield, to the surrounding farmers and market gardeners at a good profit.

LIVERPOOL.

The trade refuse collected in Liverpool is composed largely of fruit, vegetable, fish and animal matter, owing to the fact that Liverpool is one of the chief ports for the foodstuffs imported into this country. The special feature of the Liverpool destructor plant is therefore that part which deals with the offal from the abattoirs and with the vegetable, fruit and fish waste and refuse. It consists of digesters, driers, vacuum pumps, disintegrators and fat reception tanks, all of which are operated by electric power. The waste food material on receipt at the destructor works is dumped into a digester, which is then hermetically sealed and steam is turned on. The treatment in the digester is continued for a period of from four to six hours, at a pressure of 40 lb. per square inch. This treatment liquefies all the fat and the contents are then drawn off and are cooled in one of the fat recovery tanks. The fat solidifies and rises to the surface and can be collected, while the residue of the solid matter in the digester is passed to a vacuum drier, and after removal of the moisture is ground to a powder. This material is either sold in this state for poultry food or is treated with some of the liquid from the digesters and is conveyed while still hot to the Corporation piggeries. Bones are collected separately and after cleaning and boiling to remove the fat are sold for various purposes. Oyster shells are also collected separately and ground and sold, while waste paper, scrap iron, and old tins are either baled or pressed into billets, and sold to the merchants who deal in these particular classes of waste material. No figures are available for the value of the various salved materials.

(To be continued.)

The Centenary of Aluminium.

By W. W. HALDANE GEE, B.Sc., M.Sc.Tech.

THE uses of aluminium and its alloys have become so numerous and important that "the age of aluminium" may be applied, with some justification, to this part of the twentieth century; hence the centenary of the first isolation of the metal deserves more than a passing notice. This article will deal with the history of aluminium, bringing up the record to the period when electrometallurgists established processes for its abundant and relatively cheap production. Many original papers have been consulted and information has been embodied which hitherto has not been published in a collected form.

That aluminium is the most abundant of the metals in the crust of the earth, even exceeding iron, was known to the early chemists; but whilst the compounds of iron yielded to the most primitive methods of metallurgy, aluminium resisted all attempts at its isolation. In 1782 Lavoisier said that it was highly probable that alumina is the oxide of a metal, whose affinity for oxygen is so powerful that it cannot be overcome by carbon or by any known reducing agent. The invention of the Voltaic battery enabled a new source of energy to be applied. A new epoch—that of electrometallurgy—then opened.

The Discoveries of Sir Humphry Davy.—The use of a primitive type of Voltaic battery of many cells in series enabled Sir H. Davy, in 1807, to isolate potassium and sodium, but he had no success with aluminium compounds. He remarked that, had he been fortunate enough to extract the metal, he would have given to it the name "alumium." Later, however, being influenced by the argument that it was usual to name a metal after its oxide, he changed the proposed name to "aluminum," which now is written, more euphoniously, aluminium. He further attempted to isolate the metal by the aid of the powerful reducing agent potassium, but only failure resulted.

Gay-Lussac and Thenard.—The discovery of potassium and sodium and other work of Davy caused great interest and emulation in France, with which country England was then at war. Napoleon I., out of a spirit of rivalry, granted funds for the construction of a great battery which should be much larger than that used by Davy. Two of the most eminent of the then living French scientific men Gay-Lussac and Thenard, were entrusted with its design. It is described in their "Recherches Physico-Chimiques" (1811). Six hundred pairs of zinc and copper plates were used, the exciting liquid was dilute sulphuric acid used alone or mixed with common salt. The current from the battery decomposed potash and soda with great rapidity, the metals burning, as they were separated, with jets of fire like small volcanoes. The action soon ceased and in about twenty minutes the battery had run down. As a means of preparing the alkaline metals the great battery hence proved useless. The investigators were most desirous of having at their disposal potassium and sodium for research purposes, so they sought for practical methods of a purely chemical kind. They were successful in accomplishing this by passing melted potash or soda down a clay tube containing iron heated to a high temperature. Later experimenters substituted carbon for iron, so that by 1825 laboratories all over the world had samples of fairly pure potassium and sodium available for lecture and laboratory purposes.

Oersted's Experiments.—The next step towards the isolation of aluminium was due to Hans Christian Oersted, one of the most illustrious of Denmark's scientific men and philosophers. His discovery of the action of an electric current on a magnetic needle in 1820 was the foundation of electro-magnetism. When Davy visited Scandinavia in 1824 he became personally acquainted with Oersted, and it is thought that the subject of the separation of aluminium was discussed between them. Oersted, although he was chiefly concerned with physical subjects, became interested, and he came to the conclusion that the metal was more likely to be obtained by the reduction of the chloride than of the oxide. Accordingly he resolved to try to produce a chloride of aluminium. He was successful in making this by heating a mixture of alumina and carbon over which he passed a current of chlorine gas. The next step was to try to reduce this chloride by potassium. To facilitate the manipulation he decided not to use potassium alone, but to amalgamate it with mercury. He found that the amalgam readily acted on the chloride. He then drove off the mercury by heating the product of the reaction in an air-free space. A residue resulted of the appearance of a white metal, which he concluded was the long-sought-for aluminium. The account of these experiments was published in the "Proceedings" of the Royal Danish Society in 1825.

Wöhler's Methods.—At this time at Stockholm, in the neighbouring country of Sweden, the famous Berzelius was attracting by his chemical and electro-chemical discoveries students from other countries. Amongst them was a young German, F. Wöhler, who also became acquainted with Oersted. Some details of their friendship can now be gathered from the "Correspondence de H. C. Oersted avec Divers Savants," edited by H. C. Harding, of the Copenhagen Polytechnic. We learn that Wöhler and Oersted met in 1824, and the former translated into German the Swedish paper concerning aluminium. It is surmised that Oersted was busy with other scientific work, and he was willing that Wöhler should supplement his researches on the isolation of aluminium. In 1827 Wöhler obtained an appointment as a teacher of chemistry at the newly founded trade school in Berlin, and one of the first uses that he made of his laboratory was to repeat the experiment of Oersted. With the process as detailed by Oersted he was quite unable to obtain any definite results, and he concluded that the presence of mercury prevented the isolation of the aluminium. He therefore decided to use potassium alone. After a number of trials he adopted the method of using ten little balls of potassium, each about the size of a pea, which were placed in a crucible. Over the metal was added aluminium chloride, made by Oersted's process, taking care to avoid any excess. The crucible was then heated by a spirit lamp and a brisk action ensued. After the crucible had cooled he plunged it into a large volume of water, when a grey powder sank to the bottom. This he collected and dried and carefully examined. On crushing the powder small bright pellets resulted. Further tests convinced him that he had undoubtedly obtained aluminium. He was unable to fuse the grey powder and obtain a compact mass of the metal, but he used it for obtaining several compounds of aluminium. This discovery of the undoubted isolation of aluminium was published in Poggendorff's "Annalen der Physik und Chemie," Vol. XI., 1827—a century ago. It was printed in the early portion of the third volume of that year, so that probably the research was completed in June or July of 1827. It was not until the following year that translations appeared in English and French.

Eighteen years elapsed before Wöhler published anything further relating to aluminium. In 1845 he described a new method for its production by passing the vapour of aluminium chloride over potassium, the operation being conducted in a heated platinum tube. Small spheres of the metal were so obtained, which enabled him to estimate the specific gravity of aluminium as between 2·50 and 2·67. He sent a copy of his paper to Oersted, reminding him that the latter's discovery of the chloride was the basis of the new method.

Whether Oersted had really succeeded in isolating aluminium has been much discussed, some think that only an alloy resulted; but J. Fogh, in a paper to the Danish Scientific Society, maintained that Oersted's process can produce the metal. If this is the case, then Oersted's name must replace that of Wöhler as the discoverer of aluminium. Oersted himself made no claim to priority. He died in 1851, and so did not live until aluminium was produced on a commercial scale.

Wöhler's Third Method.—Wöhler's interest in aluminium having been revived, he was anxious to obtain the metal in larger masses. He returned to the crucible method with the modification that he now covered the reagent with a layer of potassium chloride. After strongly heating the crucible in a coal fire he obtained from the bottom of the crucible aluminium in a compact form. This result was known in England in 1845, when Wöhler communicated it in a letter addressed to Thomas Graham, who made it known to the Royal Society of London.

Deville's Researches.—The year 1854 begins a new epoch in the history of the metallurgy of aluminium. France now becomes the country to which our attention must be directed. The chief investigator concerned was Etienne Henri Sainte-Claire Deville. At the Ecole Normale at Paris he was engaged on research work, in which he had already distinguished himself by the publication of thirty-four papers. He prepared a quantity of aluminium in the form of the grey powder, as obtained by Wöhler, but used sodium instead of potassium for the purpose of the reduction. This powder was introduced into a glass tube and strongly heated. On passing over it the vapour of aluminium chloride mixed with hydrogen some double chloride of aluminium and sodium distilled over, and he found that the powder had been converted into large drops of metal which had been freed from the impurity sodium. This was the first of a long series of trials of new ways of obtaining aluminium in a state of purity. He found the pure metal had a specific gravity of 2·56, that it was malleable and ductile in the highest degree, had a tenacity approaching that of iron, and a melting point about that of silver. It was completely unalterable in dry or damp air, did not tarnish, was insensible to the action of sulphuretted hydrogen, withstood the action of boiling water, and was little affected by

nitric and sulphuric acids. A metal with the colour of silver and so unalterable and lighter than glass, he said, ought to come into general use. These statements were made in a communication to the French Academy of Sciences. After Deville had concluded the reading of his paper, Thenard remarked how much it was desirable that such remarkable experiments should actively continue. The work being costly, funds should be provided for the purpose. This proposition was approved and a recommendation was sent to the financial authorities. After the publication of Deville's paper in the *Comptes Rendus* a curious letter was received by the Academy from a M. Schratz, who directed attention to the work of his uncle Wöhler, who had obtained aluminium by a process like that of Deville. This caused Wöhler to send in reply a letter saying that he did not know M. Schratz, and the only nephew he had was a little boy. He directed attention to his work of 1845, which appeared to be unknown in France, and said that he was much interested in the work of Deville and thought that it would be a great service to science, and even perhaps to industry, if an economical and easy process of reduction could be obtained.

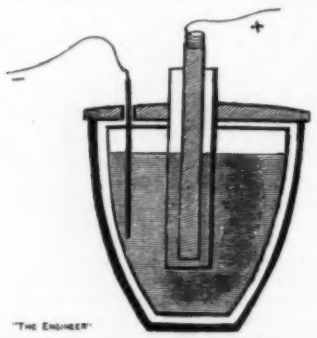
The Schratz incident does not appear to have been explained. Deville was certainly ignorant of Wöhler's work of 1845, but in replying to Wöhler he claimed to be the first to obtain aluminium in a pure condition.

With a grant of 2000f. Deville was able to continue his experiments on a larger scale, and he exhibited in the August of 1854 several bars of aluminium. Napoleon III., on learning of the remarkable lightness of the metal, thought that it would be suitable for the armour and helmets of the French Cuirassiers. At his instigation and an expense of £1500 Deville installed at Javal a works for the production of aluminium on a large scale. The first ingot obtained was made into medals with the bust of Napoleon III. on one side and on the reverse the name Wöhler and the date 1827. Some time later the Emperor designated the two chemists as officers of the Legion of Honour.

Cryolite.—Deville's success in obtaining aluminium in quantity, although at great cost, stimulated chemists to find some cheaper and easier process not depending on the use of aluminium chloride, whose preparation was troublesome. It was suggested that the natural double fluoride of aluminium and sodium, called cryolite, which had been discovered in some abundance in Greenland, would be a suitable substitute.

The German chemist H. Rose communicated to the *Philosophical Magazine* in 1855 an account of "A New and Advantageous Method of Preparing Aluminium." He had learnt that Cryolite was being sent to Berlin by way of Copenhagen from Greenland under the name of "mineral soda." It was used by soap boilers, who produced from the mineral a soda solution, which was especially suitable for making some kinds of soap. Rose succeeded in reducing the cryolite by sodium and obtained large globules of aluminium. Wöhler also experimented with cryolite, and Dr. Percy, the English metallurgist, made aluminium in the same way and exhibited samples at the Royal Institution. What use Deville made of cryolite will be subsequently described.

Early Electrolytic Methods.—Aluminium cannot be obtained by the electrolysis of aqueous solutions of its salts, but if the dry compound be fused it becomes a conductor of electricity and aluminium is separated at the negative electrode. Deville in this way was able to produce aluminium in a relatively easy manner. He electrolysed the double chloride of aluminium and sodium in the apparatus shown below. A porcelain crucible is contained within an earthenware one,



DEVILLE'S ALUMINIUM-PRODUCING CRUCIBLE

which latter is covered with a lid of the same material. Fitting in central holes of the crucibles is a porous cylinder provided with a rod of carbon for the positive electrode. For the negative electrode a platinum plate is used. The porcelain crucible and porous pot are filled with the double chloride and the crucible is heated until the salt is fused. When the electrodes are connected with a battery of five cells aluminium is obtained in powder form. The electrodes and porous pot must now be withdrawn and the pot heated until the aluminium fuses into a compact mass at the bottom of the crucible. Thus without the use of potassium or sodium aluminium can be obtained, but the process cannot be used commercially on account of the cost of the electrical energy from primary cells. Bunsen, about the same time, also used the method. It is of interest as pointing out the way of obtaining aluminium by the electrolysis of fused salts.

The Aluminium Industry in France.—By 1859 Deville had organised industrial methods for the manufacture of aluminium on a large scale, the details of which are described in his work "De L'Aluminium: ses Propriétés, sa Fabrication et ses Applications," published in that year. He acknowledges the help given to him by manufacturing chemists in establishing the successive works at Javal, Rouen, Glacière, and Nanterre. The method of preparation followed at Nanterre depended essentially on three materials: (1) the double chloride of aluminium and sodium, (2) sodium, (3) cryolite. The chloride was mixed with cryolite to serve as a flux, and with sodium in small pieces, and the reaction was conducted in specially designed furnaces. From Nanterre the works were removed to Salindres. Here on the average 2000 kilos. of the metal was produced annually, the selling price being about 100f. per kilogramme.

The Aluminium Industry in England.—About 1859 the first attempt to make aluminium commercially in England was conducted at Battersea by the sodium-cryolite process. In 1860 Messrs. Bell Brothers established a works near Newcastle-on-Tyne under Deville's supervision. Improved methods of making alumina by Webster in 1881 led to the formation of the Aluminium Crown Metal Company, near Birmingham. Five years later Castner improved the method of making sodium. The patents of Webster and Castner were taken over by the Aluminium Company at Oldbury. This was a most noteworthy attempt to produce the metal on a large scale. A capital of £400,000 was raised and the works started in 1888, but all financial calculations were overthrown by the electric furnace patents, which brought the price of the metal much below that which was attainable by a sodium reduction method.

The Dynamo and the Electric Furnace.—The introduction of commercial dynamos made it possible to furnish electrical energy at a sufficiently low cost to induce experimenters to convert it into heat for furnace purposes. The Cowles brothers applied this method for making aluminium alloys. For the production of aluminium itself we are indebted to Hall in America and Héroult in Switzerland. By 1903 there were nine works in the world working either the Hall or Héroult furnace, using about 36,000 H.P. derived from water power, producing 8000 tons per year. In 1913 the world's production reached 147,000 tons.

Conclusion.—This account of the birth and growth of the aluminium industry leaves a great mass of detail undescribed and many unsuccessful methods unmentioned, but sufficient has been included to show that the history of the metallurgy of the metal furnishes a striking lesson in evolution. The modern furnace method has now reached a stationary stage, yet it would be very unwise to think that no further improvements are to come. If recent attempts succeed in substituting clay for bauxite—the chief raw material now used—there will be a new epoch resulting in lowering the present price—about £107 per ton—of the metal.

DESPITE the rebate of 5 per cent. in the carriage charges offered by the Great Western Railway where coal for export is carried in 20-ton wagons, the provision of such higher capacity wagons by private owners makes little progress. Speaking at the Cardiff Chamber of Trade on the 24th ult., Colonel Wilfrid Ashley, the Minister of Transport, said that whilst the railway company had provided 951 wagons since the beginning of 1924 the private owners had added only 215.

Institution of Mechanical Engineers.

ON Friday evening of last week, Mr. E. G. Herbert presented before the Institution of Mechanical Engineers a report, made to the Cutting Tools Research Committee, on the effect of cutting temperatures on tools and on materials subjected to work. The meeting was somewhat poorly attended and the ensuing discussion did not reach a very high level.

The main idea about which the work described in Mr. Herbert's paper has revolved can be briefly stated. The effect of cutting metals is twofold. It heats the tool and it work-hardens the metal being cut. The significant factor in the process is therefore the hardness of the tool when hot and the work-hardening capacity of the metal. The cold-hardness of the tool and the original hardness of the metal can, Mr. Herbert argues, have no significance in relation to the ability of the one to cut the other, for both these factors disappear as soon as cutting is begun.

Mr. Herbert divided his paper into three sections.

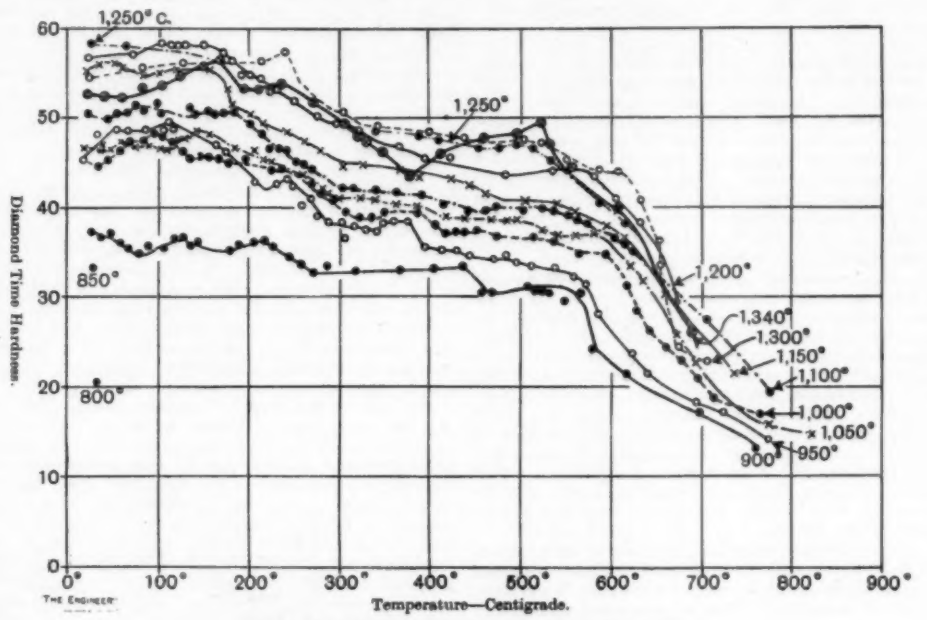


FIG 1—HOT-HARDNESS OF QUENCHED TOOL STEEL

In the first he dealt with the hot-hardness of tool steel. In the second he discussed the effect of cutting temperatures on the metal being cut. In the third he summarised some investigations he has made with the object of discovering the source of work-hardening changes in metals.

The hot-hardness of tool steel with which Mr. Herbert is concerned is its hardness at temperatures from 250 deg. to 650 deg. Cent., a range the greater part of which is below red heat. To measure hot-hardness he employed the time test made with his "Pendulum" hardness tester provided with a spherical-faced diamond of 0·5 mm. radius. The specimen of tool steel to be tested was placed in an electric furnace. The tests were begun with the furnace cold and were continued until the tool steel softened. The temperature of the specimen was measured by means of an iron-constantan thermo-couple inserted in a hole in it.

The steel selected for examination was "A.W. Premier" high-speed steel, a material containing 18 per cent. tungsten, 4 per cent. chromium, and 1 per cent. vanadium. One set of specimens was hardened by quenching from temperatures ranging from 800 deg. to 1340 deg. Cent. In the cold state the hardness was found to rise regularly with the quenching temperature from 800 deg. to 1250 deg. and then to fall up to 1340 deg. Cent. As the temperature of the test specimens was raised in the electric furnace the hardnesses recorded varied in the manner shown in Fig. 1. At a furnace temperature of 500 deg. the recorded hardnesses, it will be seen, rise regularly with the quenching temperature. The same remark is generally true at furnace temperatures of 300 deg., 400 deg. and 600 deg., except that the specimen quenched at 1340 deg. is out of series at these temperatures. The specimen quenched at 1300 deg. was regarded as the best, for it had the highest hot-hardness over the range —300 deg. to 600 deg.—of high-production cutting temperatures and retained its hardness to the highest temperature, 610 deg.

The second series of test specimens was quenched at 1300 deg. Cent. and then given a secondary heat treatment at various temperatures ranging from 420 deg. upwards to 700 deg., and then allowed to cool naturally. Fig. 2 shows the hot-hardness curves obtained from these specimens together with the curve for the specimen hardened at 1300 deg. without secondary heat treatment. The secondary treatment at 650 deg. and 700 deg. lowered the hardness over nearly the whole range of temperatures. Secondary treatment at 575 deg. and 620 deg. raised the hot-hardness over that of the hardened only specimen at

all temperatures between 250 deg. and 600 deg. The specimen heat treated at 575 deg. was held to give decidedly the best results.

The curves given in Fig. 2 are held by Mr. Herbert to suggest a ready means of appraising the merit of high-speed steel tools. He proposes the adoption of a "figure of merit"—such as 40/600—denoting a diamond time hardness—40—at a certain temperature—600 deg. Cent. The figure of merit would be selected with regard to the class of work on which the tool might be required to operate.

In the second part of his paper Mr. Herbert sought

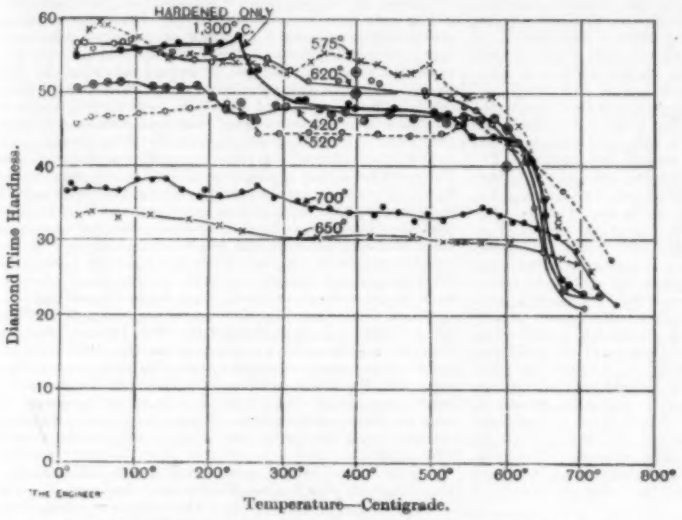


FIG. 2—HOT-HARDNESS OF QUENCHED AND HEAT-TREATED STEEL

to provide additional evidence to the effect that resistance to cutting does not depend upon the original hardness of the metal cut, but on the induced hardness in the path of the tool, which induced hardness, he holds, depends on the work-hardening capacity of the metal. Fig. 3 shows the "Pendulum" time hardness figures given by a chip of stainless steel before it separated from the bar. The original hardness of the bar was 18, while that in the path of the tool was 37·8. The built-up edge had a hardness of 49·5, but this structure is to be regarded, says Mr. Herbert, as a cutting implement rather than as a part of the work material. The two elliptical impressions were made by the Pendulum "time work-hardening" tests in which a succession of time hardness tests are made on the one spot, the Pendulum ball being rolled twice over the spot between each test so as to develop

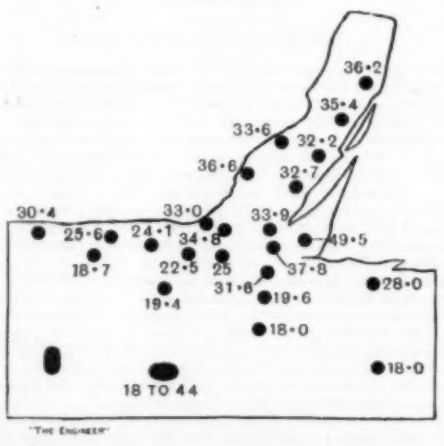


FIG. 3—HARDNESS OF STAINLESS STEEL CHIP

the work-hardening capacity of the metal. After ten passes of the ball over the spot the hardness of the stainless steel—Fig. 3—had changed from the original value of 18 to the induced hardness of 44. Similar tests made on other metals showed that the hardness induced by the tool in the metal it was about to cut was approximately equal to the hardness induced by the first *two* passes of the ball in the time work-hardening test.

Mr. Herbert proceeded to show that the work-hardening capacity of a metal varies with its temperature. Fig. 4 shows the effect of temperature on work-hardening capacity in the case of a steel containing 0·83 per cent. manganese and 0·65 per cent. carbon. The three peaks and the three depressions are characteristic. The depression D2 is the most important feature. It occurs in steel and iron at temperatures from 120 deg. to 150 deg. Cent. and in non-ferrous metals generally below 100 deg.

Apart from the effect of these changes in work-hardening capacity on the cutting of metals, Mr. Herbert studied their effect on ductility and the behaviour of the metals in press work operations. He found that the peaks P1 and P2 were comparatively unimportant in their effect on ductility, that there was a marked *minimum* ductility corresponding to the depression D2, and that the principal change of ductility occurs in the range of temperatures between room temperature and that corresponding to P3. The fact that the ductility is apparently least when the work-hardening capacity is a minimum is commented upon and an effort is made to explain it on the ground that a metal with a low work-hardening capacity fails in press work by serious weakening at one point, whereas a metal with a high work-hardening capacity fails by a succession of local extensions. The same phenomenon has been noted in connection with tensile tests on metals having high and low work-hardening capacities.

In the third part of his paper Mr. Herbert discussed the source of changes in work-hardening capacity with changes of temperature. His investigations of this subject took the form of straining polished specimens at the critical temperatures corresponding with D2, P2 and P3, and examining the flow pattern produced in the polished surface. In addition, he carried out temperature work-hardening tests on single crystals of aluminium, and on very large crystals of iron. The inference drawn from the results of these various tests is that the phenomenon is one of crystallisation, and that in both iron and aluminium it is affected by the presence or absence of boundaries. The investigation is to be continued.

Mr. William Taylor was the first speaker in the discussion. He had, he said, no criticism to offer, and was full of admiration for Mr. Herbert's genius. The methods described in the paper supplied the means, long sought, of determining the merits of a cutting tool otherwise than by testing it to destruction. The characteristic dips in the work-hardening curves were the scientific explanations of certain familiar practical facts. If a piece of clean watch spring were held bent in a flame, it would be found that it acquired a permanent set long before the temperature rose sufficiently to destroy the temper. The set occurred when the spring reached Mr. Herbert's D2 point. Again, it was well known that sheet zinc could be bent as easily as sheet lead if it were plunged into boiling water. These examples illustrated properties of materials of which we ought to take practical advantage. For too long we had neglected the science of the workshop. Our studies

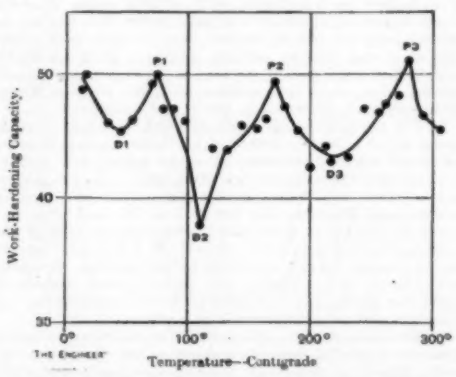


FIG. 4—WORK-HARDENING CAPACITY OF STEEL

of materials had aimed at the production of structures that would endure. We had failed to devote equal attention to the means of breaking them down. In connection with recent developments in high-pressure boilers, much research work was now being carried out on the strength of metals at high temperatures. He thought it would be very desirable if some of the attention paid in that quarter were turned in the direction of studying the workshop properties of metals. In years to come, he prophesied, Mr. Herbert's work would be ranked in importance with that of Beauchamp Tower on the friction of bearings. Mr. Herbert combined a faculty for scientific research with a keen understanding of practical needs. He hoped that that combination would become more general among scientific workers in the future.

Mr. R. C. Macdonald regretted that Mr. Herbert's paper had not been read several years ago. A number of years back he had the task of punching 4in. diameter holes in light armour plate, about ¾in. thick. The press employed failed after the first plate or two had been punched. The plates as they were punched made a loud ringing noise. Without any scientific guidance such as Mr. Herbert's paper, had it been available, would have afforded him, he heated the plates to a temperature which was not measured, but which was probably round about 250 deg. Fah. The plates then punched very nicely and very seldom went with a ring. He thought it was now obvious that they must have been heated very nearly to the D2 point. Mr. Herbert's paper was of significance from many points of view, not the least interesting of which was that of the machine tool builder. He could almost foresee the day when our machine tools would represent combined furnaces and cutting equipments.

Mr. F. E. Robinson thought that Mr. Herbert's paper would require a good deal of digestion, and a considerable amount of practical confirmation. He agreed with Mr. Herbert that a diamond hardness tester did not always give a result on high-speed steel in the cold state comparable with the behaviour of the tool in practice. He anticipated, however, that the Sheffield steel manufacturers would not accept Mr. Herbert's proposed "figure of merit" without considerable argument. Dealing with the author's experiments on single crystals of metals, he said that his own experience had taught him that in such work as the drilling of very long holes the form of the crystal growth in the original ingot had much to do with the machinability of the resultant metal. Micro-photography and analysis showed nothing to account for the difference observed in the machining qualities of different batches of steel. Inspection of the macrostructure suggested that the difference was determined by the manner in which the fibrous crystals were drawn out and interlaced. Straight banding gave beautiful drilling results, but if the fibres crossed each other it was difficult to obtain other than a rough hole.

Principal G. S. O'Riordan said he could confirm Mr. Taylor's remarks regarding the neglect of the science of the workshop. It was wofully neglected. The fault was not altogether that of the technical institutions. Employers had not done all they might have done in the matter of promoting workshop research. Some engineering employers were a little suspicious of technical institutions and made it difficult for those bodies to discover what subjects it would be worth while investigating. He was glad at all times to hear of practical workshop problems which might be made the subject of scientific research, and instanced Mr. Robinson's drilling observations as typical of the kind of work he was desirous of conducting.

Sir Henry Fowler at this point interposed and asked speakers to keep to the subject of the paper. Workshop science would, he suggested, form an excellent theme for discussion at an informal meeting.

Mr. C. W. J. Taffs called attention to the fact that Mr. Herbert had not included a description of his "Pendulum" hardness tester in the paper, and suggested that it should be embodied in it when it was reprinted in the "Proceedings." He had seen a "Pendulum" tester in operation at Birmingham University, and was delighted with its simplicity and the consistency of its results on high hardnesses, such as 600 Brinell. The device, he suggested, reflected what might be called the velvet pile effect of the surface of the specimen. The work-hardening effect could not have been investigated except by means of the "Pendulum" tester.

Mr. W. F. Cully asked whether the grinding and lapping of a specimen preparatory to submitting it to a "Pendulum" hardness test would not work-harden the surface and so lead to false results. In the manufacture of watch springs, it was the practice after hardening the springs to stretch them, and finally finish them off by a hand-lapping process. He had been assured by a manufacturer of such springs that the fine results obtained were almost entirely produced by the final lapping process, which, he suggested, caused the material to be work hardened.

Lt.-Col. Kitson Clark followed up Mr. Taylor's remarks regarding workshop science by giving particulars of an awkward piece of flanging work which at first caused difficulty. Some time after the plate had been flanged the flange cracked right down to the bottom. Expert advice was sought and pyrometers were fitted to the flanging furnace. The flanges continued to crack. Good results were not obtained until the control of the furnace was left entirely to the judgment of the furnaceman's eye.

Professor P. M. Baker, like Mr. Taffs, desired to see an account of the "Pendulum" hardness tester placed on record in the "Proceedings." It was, he said, a most interesting device to use, but he had some doubts as to whether in the process of polishing and preparing the specimen the properties of the material were not changed.

Mr. S. G. Williams argued that the term "hardness" was used very loosely and asked for a definition of it. He thought that hardness had fundamentally something to do with the molecular structure or orientation possessed by the material exhibiting it. Graphite and diamond were, for example, chemically the same. They differed in their molecular arrangement and were very different in their hardnesses. Some materials could be machined more readily than others which were apparently softer. Hardness as commonly understood was not, in his view, the property of a metal which determined its machinability.

Mr. A. J. Shrimpton, speaking as a physicist, said

that we had no mental picture of what was occurring in a metal subjected to a "Pendulum" hardness test. What was the true action of the device? During a series of tests carried out at different temperatures did the material pass through a plastic stage? If so, he thought that during that phase the Pendulum figures would be influenced by a frictional effect.

Mr. W. H. Patchell expressed regret that the paper had been presented as a contribution to the work of the Cutting Tools Research Committee. Everyone working materials in the hot condition ought to see it. Mr. Herbert's work would, he thought, be of benefit to boilermakers, particularly when they were called upon to deal with nickel and other alloy steels.

Sir Henry Fowler, in closing the discussion, said that he looked forward to the time when he would be able to buy his tool steel on a "figure of merit" basis.

Mr. E. G. Herbert, replying to Mr. Taylor, said he had made repeated tests on the work-hardening capacity of hardened steels at different temperatures and had never found any sign of the D2 point. It was almost always present in unhardened steels. These facts seemed to dispose of the suggestion that the set developed by gently heated watch springs occurred at the D2 point. The ability to bend sheet zinc when it was heated to 212 deg. Fah. was probably a D2 effect, but he could not say at what temperature that effect occurred in zinc. He had tried to determine it, but had been defeated by the crystalline nature of zinc. Mr. Macdonald's experience with armour plates was almost certainly a D2 effect. The temperature mentioned, 250 deg. Fah.—or 120 deg. Cent.—was just the temperature characteristic of the D2 point in steel. Mr. Macdonald need have no fear of revolutionary changes in machine tools. The real trouble lay in keeping the tool cool and not in making arrangements to warm it up. Replying to Mr. Robinson, he said that he was already looking forward to a lively and interesting time when he came to present his paper at Sheffield. It was remarkable how little precise knowledge those who sold high-speed steel possessed regarding the softening point and other important factors connected with their wares. Mr. Taffs and Professor Baker had asked him for a description of the "Pendulum" tester. It had often been described before, but as its inventor and as one interested commercially in its sale he had thought it desirable not to dwell in the paper on its constructional features.* He would, however, endeavour to supply the information desired. Replying to Mr. Williams, he said that he could offer no definition of hardness. Dealing with Mr. Cully's remarks, he stated that the machining of specimens appreciably hardened them, but he did not think a slow lapping process could work-harden them. The improvement in the quality of the watch springs referred to by Mr. Cully was probably not caused by work-hardening during the lapping process, but by the creation on the springs of a very smooth surface. The removal of very fine scratches always improved the resistance of metals to fracture. Forging temperatures such as those involved in Lt.-Col. Kitson Clark's flanging work did not come within the range of his experiments. Discussing the action of the Pendulum tester, he said that the diamond or steel sphere always made an impression in the metal. The radius of the impression was found to be about 30 per cent. greater than that of the ball. It varied with the hardness of the metal. Benedicks had shown that the quicker the movement of the Pendulum the smaller was the radius of curvature of the impression. He agreed with Mr. Williams that there was no connection between machinability and the hardness of the metal machined as ordinarily determined, for the ordinary hardness test measured the original hardness and not that induced in the metal by the cutting action of the tool. He did not agree with Mr. Shrimpton in the matter of friction and its influence on the "Pendulum" figure. He had watched a "Pendulum" tester swinging for three-quarters of an hour and had failed to detect any signs of frictional effect.

Automatic Liquid Analysis.

At a meeting of the London Section of the Society of Chemical Industry, held at Burlington House, London, on Monday, December 5th, Dr. H. S. Hatfield described and exhibited an instrument for automatically titrating a measured volume of a liquid with a standard reagent, recording the result, and repeating the operation indefinitely.

Dr. Hatfield said that the automatic chemical analysis of liquids had only recently attracted the attention of instrument makers, in spite of the fact that corresponding instruments for furnace gases had long been in use. In recent years technical instruments for the automatic recording of hardness values and control of technical processes by such means had been described in America, but so far as he was aware they had not yet found their way into this country. The only practical case known to him in this country of automatic liquid analysis was the recently introduced apparatus for automatically determining the amount of oxygen in boiler feed water. He had been led to develop the apparatus through a case particularly adaptable to it, viz., the titration of hard water with standard soap solution, the well-known Clark's test. Whereas the end point in the laboratory was determined by the formation of a permanent lather on shaking, the end point in this apparatus was determined by blowing a stream of air through the water under test, with gradual addition of soap solution. When excess of the lather is attained, he said, a mass of froth is formed which overflows the edge of the vessel. The stream of air also serves to stir the liquid during the addition of soap solution. The rate at which the tests are taken can be regulated electrically, and the results of the tests are also permanently recorded automatically.

Dr. Hatfield pointed out that apparatus of this kind can be applied to the control of water-softening plants in two ways. In the first, the water before entering the plant is automatically tested for hardness and the amount of softening chemical added is automatically adjusted to the correct amount. The second method consists in automatically titrating the water leaving a plant and causing the apparatus to give a signal, or effect a change-over of some kind, when the hardness of the effluent water exceeds a certain degree. This method, it was added, is more particularly applicable to base-exchange softening, and there is no suggestion to apply apparatus of this kind to the effluent of a lime-soda plant. The author demonstrated the apparatus, and showed how it will take repeated tests of the hardness of water and record the results. The apparatus has been under test for some time at the Brentford works of United Water Softeners, Ltd., and great satisfaction has been expressed with the results. The object of the apparatus is to take out of the hands of an operator the task of testing water entering a plant, and adjusting the amount of softening chemical to correspond with the result of the test. It does the whole operation automatically. At the same time, it may be made to take a sample of water leaving the plant, alternately with a sample of water entering it, and record the result of its test, the valve control mechanism being cut off while this test on the softened water is in progress. At the same time, a more simple apparatus has been devised for dealing only with water leaving a plant and it was also exhibited, although not in operation. This apparatus is arranged to take samples of water of equal volume and add to each sample a measured amount of soap solution. This particular apparatus was put forward as a safeguard, watching over the correct performance of the men in charge of water-softening plants.

* A full description of the "Pendulum" tester appeared in our issue of April 13th, 1923. Full details of its use for determining the work-hardening capacity of metals were given in our issue of March 7th, 1924.

Safety in Factories.

A museum, which has just been opened in Horseferry-road, Westminster, by the Home Office, is perhaps not of very direct engineering interest, except in so far as it is concerned almost entirely with mechanical appliances, and is rather a development of the "Safety First" campaign started a few years ago. To the engineer safety is almost second nature—witness the invariable practice of adopting a factor of safety in all calculations—but it would appear, from the statistics collected in the museum, that in general manufacturing industries and transport organisations the adoption of safeguarding schemes is a real necessity and serves a very useful purpose. Thus, taking several different factories at random and calling the old rate of accidents 100 per cent., within a year of the adoption of a "Safety First" campaign the number of accidents is reduced to from 40 to 60 per cent. of the original. Apart from the working time thus saved and the greater welfare of the workers, the scheme has the merit that insurance companies will accept lower premiums where it is adopted.

The museum, to be precise, is a permanent exhibition of methods, arrangements and appliances for promoting the safety, health and welfare of industrial workers who come within the sphere of Home Office administration. It is housed in a building with a floor space of some 10,000 square feet, which was built before the war for its present purpose, but which has only recently been available, as it was used for military purposes in the interval. It is the first exhibition of its kind in this country, although similar exhibitions have existed for some time in Milan, Berlin, Munich, Amsterdam, Paris, and Lausanne.

It will be open to the general public between certain hours, but it is mainly intended for those who are directly concerned with the problems of safety, health, and welfare in industry. Its main use will obviously be for employers and workers and their organisations. It is designed to explain and illustrate the dangers to life and limb and health incidental to industrial processes, and to show the best methods of preventing them. It will render hardly less important service to designers of factories, designers and makers of machinery and power plant, makers of guards for machinery and other protective appliances, and designers and makers of ventilation plant.

Medical practitioners who practice among workers liable, from the nature of their occupation, to one or other of the many forms of industrial disease, *e.g.*, epitheliomatous ulceration, silicosis, lead poisoning, anthrax, dermatitis, &c., will find much information that may be useful to them in the Health Section of the museum; welfare and other social workers will find information as to the best welfare methods in the Welfare Section; and Inspectors of Factories will be assisted in their work.

It is hoped by the Home Office that the engineering schools of the universities and the technical schools will make use of the opportunities afforded by the museum, and will send their students there to learn the principles of industrial safety. The museum will serve as a centre to which improvements in appliances and methods of safety, health, or welfare will find their way, and by bringing together all that is best should act as a stimulant to further invention and improvement.

The exhibits have been selected solely with a view to their usefulness. Every suggestion or offer received from inside or outside the Department has been tested by that standard. Museum "pieces" have been rigorously excluded. In the "Safety" sections of the museum the exhibits consist chiefly of actual machines, plants, and appliances as they would be installed in a factory or elsewhere. A few models are included, but models have been found by experience on the Continent not to make the same appeal as actual machines; they are not the real thing. Power is provided so that the machines exhibited can be shown in actual movement, though in most cases it will not be practicable to show the actual manufacturing process in operation. These exhibits are supplemented by an extensive collection of photographs of actual installations in different parts of the country. This collection has a twofold object, as the exhibits necessarily include only a small fraction of the many types of machinery, plant, and appliances employed in the industries of the country, and by the use of photographs it has been possible to exhibit a much wider range of protective methods and appliances. For at least one important industry, viz., the loading and unloading of ships at docks and wharves, the use of photographs was the only possible method of illustrating the dangers incident to the work and the precautions necessary.

Photographs of actual installations also serve to emphasise the fact that the protective methods and appliances exhibited do not represent a standard of perfection, which exists only in the mind of Factory Department officials and which the factory occupier or manager who has to carry on his business and get his work done cannot be expected to reach, but are in actual operation in many works. The photographs have either been taken by the official photographer of the Office of Works under the guidance of the Factory Inspectors and with the consent of the firms, or have been supplied by the firms themselves.

It is impossible within the scope of this notice to describe the exhibits in the museum in detail, as one might easily spend a week in gathering the information necessary for their description, and in this connection it is noteworthy that the members of the staff are most obliging in assisting visitors with technical and general information. We will content ourselves with one individual example as indicative of their general character. It is a sight-feed lubricator, with about a score of feeds, from which brass pipes lead upwards to the bearings of a line of shafting used to drive some of the machines exhibited. The idea is, of course, that by arranging this lubricator on the floor level it is made unnecessary to climb a ladder to attend to the bearings, and that a somewhat risky job is thus eliminated. It might appear at first that as a form of insurance the idea is rather extravagant; but we were assured that the scheme could be carried out at an average cost of about 35s. a point.

There is one other matter that developed during our brief visit, to which we will refer, as it has been discussed in these columns before. It is the insistence of the Home Office on the use of circular cutter blocks on wood planing machines, in the place of the old square cutters, on account of their greater safety. On the one side it is argued that the lesser projection of the circular cutter, as compared with the square cutter, prevents the immediate severe mutilation of the worker's hand in the case of an accident; while, on the other side, it is claimed that the cutters revolve so fast that there is not sufficient time for this depth of cut to become effective. So we discussed the matter at some length with the curator of the museum, and it was only finally settled by statistics, which showed that the extent of mutilation of planing machine operators' hands has actually been greatly reduced since circular cutter blocks became imperative. It is still a problem, however, as to whether the improvement is due to the cutter or the worker.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

COMPOUNDS ON RAIL AND SEA.

Sir,—The compound reciprocating steam engine was developed principally by the marine engineer, though it has, of course, been largely used for other purposes. It is now a considerable time since it became practically universal at sea, and there it has been carried to three or four stages of compounding. This has been the case not only in the large ships, but even in the smallest steam launches. The firm with which the writer used to be associated made quadruple-expansion engines their standard, even for small engines of 10 horse-power thirty years ago, and they were thoroughly successful. The main reason for this was not so much fuel economy as the need for keeping the weight of the boiler as low as possible.

Compounding having been such a success in other fields, it seems to be taken for granted that it ought to be equally successful in locomotives, and that if it is not generally adopted, it must be either because of the prejudice of those concerned or because compounding has been badly carried out. It is worth while to consider whether the conditions of work in a locomotive are so similar to those of the marine engine as to make the reasons for compounding the one apply to the other.

The most obvious difference between the locomotive and the marine engine is, of course, that the latter condenses and therefore exhausts into a vacuum. This, however, in itself would not condemn the compound system, for the locomotive works at pressures of from about 180 lb. upwards. Now it was found that in marine work it was an advantage to make engines triple-expansion for pressures as low as 125 lb. The pressure in the steam chest of the low-pressure cylinder of a triple-expansion engine is as high as those of the exhaust of a locomotive, so it might be assumed that if two stages are desirable in expanding the steam to this pressure in the marine engine, they would be equally so in the locomotive.

There are, however, other conditions which are very different indeed in the marine engine and the locomotive. One of these is that weight is far more important in a locomotive than a marine engine, and another is that the locomotive works over a very much greater range of speed and power. When we consider these two points, the problem of the locomotive seems to be very different in every way from that of the marine engine, or, for that matter, any other type where compounding has been successful. The weight allowable in a locomotive is obviously very limited compared with that of the ordinary commercial marine machinery. The latter usually weighed somewhere about 3 cwt. per horse-power. It is difficult to say what the exact weight of the power plant of a locomotive is, as it is so mixed up with the framing, wheels, &c., which are part of the carriage and not the power plant, but it seems likely that a good locomotive can work up to a horse-power for every ½ cwt. weight of the actual power plant. That is one-sixth of the weight of the marine machinery of about the same power. This is a very great difference and entails great differences in working, namely, very high revolutions and piston speed and high forced

draught. The conditions in a torpedo boat in the days when the locomotive type boiler and reciprocating engines were used were very much more similar to those of the locomotive and the weights per horse-power were about the same, *i.e.*, ½ cwt. per horse-power.

The greatest difference in the marine engine and the locomotive, however, is in the variation of power and speed. The ordinary marine engine does the greater part of its work at one speed and one power. It can therefore be designed for this speed and power. That is to say, that the rate of expansion, cut-off in each cylinder, area of the valves and ports, &c., are all designed for one horse-power and one rate of revolution, and the occasions when the engine is worked at some other speed and power are so few that its performance is a matter of no importance. Further, the marine engine always runs its maximum revolutions with maximum power. That is to say, that for all practical purposes we may say an increase in mean pressure in the cylinders is always accompanied by an increase in revolution. In a locomotive the conditions are the opposite to this. When starting a train or pulling up a bank the mean pressure is very high, but the revolutions low. As the speed increases, the engine is linked up and steam cut off earlier. The engine may be required to develop the full power the boiler is capable of either at low or high revolutions, the cylinder pressure being inversely as the revolutions.

These conditions do not seem to suit compounding. It is well known that a compound or triple-expansion engine run at powers and speeds varying greatly from what it is designed for is very far from economical. For this reason, warship machinery which has to be run over very varying powers has sometimes been arranged with triple-expansion engines, of which the low-pressure cylinder could be disconnected when cruising at low powers, and modern turbine-driven warships are always fitted with a cruising turbine.

In fact, judging from marine experience, one would expect that the compound engine would be more efficient than the simple, as long as it was run at the revolutions and horse-power that suited it or within a reasonable margin on each side, but that the simple would have the advantage at speeds and powers outside this margin. As the range of revolutions over which the locomotive has to give its full power is very considerable, it would seem unlikely from theoretical grounds that there would be any material total gain.

On the other hand, unless the boiler can be made smaller for a given power, the compound locomotive will be heavier, as the cylinders must be larger. Now, the boiler must be large enough to supply steam for the required horse-power over a large range of revolutions, and must therefore be large enough to supply the power at revolutions outside the economical range of the compound. It is not easy to see how it can be reduced in size, and, as a matter of fact, compound locomotives usually seem to have boilers as large as simples doing the same work.

A point to remember is that early cut-off and expansion in a single cylinder have less objections at high revolutions than low. The object of compounding is to get the needful expansion without condensation occurring, owing to the range of temperature in the cylinder. The higher the speed the less the condensation, and the smaller the possible gain from compounding. Cushioning to fill the steam space also minimises this loss, and also brings the reciprocating parts to rest without pressure on the bearings. It is well known to petrol engine designers that a very small addition to the reciprocating weights of an engine running at the piston speed of a locomotive results in a considerable loss of power, owing to the pressures on the bearings, and this would naturally be avoided if they could be brought to rest by cushioning.

Altogether, from theoretical grounds, it would seem that the simple locomotive run with late cut-off at low revolutions and earlier cut-off as the revolutions increase, meets the case extraordinarily well, and the results obtained in daily work, as compared with any marine reciprocating engines are wonderful.

The case is, of course, quite different if the locomotive is not run over a great range of speed and power. Thus, a heavy freight train running at slow speed over long stretches of flat road approaches far more nearly to marine work, and it is noticeable that the engines running such trains in the United States of America are often compound, while the passenger engines are simple.

December 5th. MARINE ENGINEER.

THE SPRINGING OF LOCOMOTIVES.

SIR,—The compensating beam for springs of locomotives has turned up again as a subject for discussion. Some years ago the question as to their utility was debated in THE ENGINEER, about the time when train resistance, Mr. Webb and compounds, the ether, "drop," young engineers, and other cognate subjects were having a turn. One correspondent summed up to the effect that at low speeds beams were not wanted and at high speeds had no time to act. He might have added that on a good track they were not wanted and on a bad one were useless or worse. My only excuse for interfering is many years' experience on tracks as bad as could be used, on engines with the half-dozen varieties of spring possible on six-coupled engines with truck or bogie. After years of observation I was unable to notice any difference in favour of compensating beams; on the contrary, the more compensation the rougher the riding. Driving over about 2000 miles of such track—as a sample, Livesey pots, 20ft. 50 lb. rails, no fish-plates and no ballast—more than fifty different engines draws one's attention forcibly to the question of springs and the movement of engines on an exaggerated scale; it gives one also a good opportunity for the study of compensating beams under a wide range of activity.

Take a simple case for examination. A four-coupled engine travelling at the rate of 40 m.p.h., *i.e.*, 60ft. per second, a low place about 6ft. long is met with on one side only; the leading wheel drops into this. The spring, relieved of part of its weight, receives "compensation" from the trailing spring. Supposing that a little less than the tenth part of a second is required for this transfer, then as the leader rises to solid ground it will return the weight to the trailer, when the trailer is in its turn on the low spot. In the meantime the roll of the whole weight above the springs further depresses the trailer and may bring the framing hard on to the top of the box, which decidedly makes for rough riding. Events may not take place exactly in this manner; but, given an endless variation of factors, it seems certain that the transfer of weight from one spring to the other will take place more or less frequently in such a way as to accentuate rolling and pitching.

Writers on locomotives—Clark, Colburn, Sinclair, Forney, Pettigrew, and others—are not helpful on the subject. Two recent correspondents in THE ENGINEER imply that these beams are in some way preventive of derailments. The synthetic analysis of a derailment is more amusing than convincing—alterations take place during derailments which often make after observation futile. Is there any evidence which would tend, however slightly, to justify the belief that compensating beams had ever prevented a derailment or that their absence had caused one? EX-DRIVER.

December 2nd.

THE ECONOMICS OF SPEED.

SIR,—In the leading article on "The Economics of Speed," in your issue of the 2nd inst., you referred to a recent speech of mine in the House of Lords, in which I commented upon the failure of the railways of this country to increase the speeds of their express trains. Perhaps you will allow me to say something about various points raised in your article.

To begin with, I entirely dissent from your view that "to the average passenger, speed by rail or sea is a form of luxury." You say in effect, "What is the use of saving time for people who are pretty sure to waste the time which you have saved for them?" That is a form of argument which can equally well be employed to demonstrate the uselessness of any kind of improvement or even of life itself—"What is the use of people being born when they are pretty sure to waste their lives?"—and at once transports you into the realm of philosophy into which I shall not attempt to follow you.

I start from the assumption that the life of each one of us consists of so or so much time, which can be used or wasted, and that time spent sitting in a railway carriage is usually wasted. It is therefore a matter of public importance to reduce the time so spent to the lowest point so long as this can be done at an expense not greater than the value of the time saved.

Existing roads, rolling stock, signals and brakes are amply sufficient for an increase of speed up to 75 miles per hour, start to stop, on the best of our existing lines—*e.g.*, Paddington–Bath, King's Cross–Peterborough, Waterloo–Salisbury—and the only thing required is increased power.

On July 22nd last you published an article by me describing the work of the new 4–6–2 compound engines of the Chemin de fer du Nord. The maximum power developed by these machines was obviously vastly in excess of anything required to work the fastest and heaviest trains in this country. There is nothing in the leading dimensions of these engines—axle weights, maximum diameter of boiler, diameter of driving wheels—that need prevent similar machines with rather shorter chimneys and narrower side footplates from working over British lines. I was not able to take the coal consumption of these engines, but one of them took the "Golden Arrow"—weighing 430 British tons behind the tender—from Calais to Paris (184 miles) in the equivalent of 178 min., when suitable allowance is made for loss of time from permanent way repairs and adverse signals, and used 29 tons of water (345 lb. per mile). As the engine was fitted with a feed-water heater, it is reasonable to suppose that 1 lb. of good steam coal would evaporate 8 lb. of water. It would therefore appear that this work was done on the equivalent of 43 lb. of good steam coal per mile. No very serious expense for coal need therefore be anticipated when greater power is required. Indeed, the only serious increase in expenditure that I can think of is, perhaps, for boiler maintenance, for which I suggest that 1½d. per mile—the fare of one third-class passenger—is a suitable allowance.

With regard to the road, certainly the London and North-Eastern, and I think also the London, Midland and Scottish, have issued communications to the Press stating that their trains which make the runs of exceptional length, attain maximum speeds of 85 miles per hour. So there is obviously no objection to such speeds. If there were, these very slowly-timed trains could easily keep time without anywhere exceeding 70 or even 65 miles per hour.

In view, indeed, of the general attitude towards speed adopted by the railway companies, it is pretty obvious that the strength and solidity found in the best British roads are due to the fact that such strength and solidity are in themselves economical. They were adopted in no way with the object of making the roads safe for increased speeds. The increased capacity for speed which they give is merely a sort of accidental by-product. It seems to me that it is a great pity that this process has not been carried a great deal further and the roads made suitable for much higher speeds still, which would in turn have produced yet further economies in working. These further improvements would obviously have consisted for the most part of by-pass lines involving the purchase of land in the neighbourhood of large towns which fifty or sixty years ago might have been bought at a small fraction of its present price. But the railways had not the foresight to do this.

As regards getting trains over the line and turning them round, you have yourself drawn attention to the fact that acceleration is, or may be, an important advantage.

MONKSWELL.

London, W. 2, December 5th.

THE MAN AND THE JOB.

SIR,—There is one point in the interesting series of letters called forth by your leading article "The Man and the Job" which appears in danger of being overlooked. I refer to the fact that the "training of engineers" is much more complex than it is usually considered to be. There is, first of all, the great body of young men who will necessarily remain in the rank and file of the industry; then we have those who will be draughtsmen, foremen, under managers, &c., a class relatively small in numbers, but very important; finally, we have that still smaller class who will take the final responsibility in the various fields of engineering work. These divisions are obviously not water-tight, and the opportunity of passing out to a higher class is really greater here than on the Continent.

At present, one may say, the first section is generally not specifically catered for; only those who would raise themselves to the second section receive any definite provision in most places in this country. The second is, on the whole, well provided for in the day and evening technical institutes. But it is, presumably, of the last section you wrote, since you made comparison with the highest type of engineering school in America, viz., that connected with a university. My remarks, therefore, are confined to these, although, in my opinion, the first section really needs much more attention in this country.

Even if one considers the relatively small number of men turned out each year by our universities, the work ultimately undertaken by them is extremely diverse. So that the system necessarily provides roughly for only an "average engineer." Do we, in this country, imagine for a moment that an engineer can, in the average case, be trained in a college to be of immediate usefulness in the industry? Most emphatically we do not. We think of five years at least as the time in which a young man will be trained, and of this he will spend three years of about thirty weeks each at college. In this short length of time all that can be attempted is to teach him the scientific basis on which modern and, still more, future engineering must be founded.

On the personal side, the student has ample opportunities to develop, and those one recommends for the "average" type of post are generally the "all-round" men. But there is, nevertheless, a demand to-day for the man who succeeds best, not necessarily in getting on with other men, but in delving into the more abstruse scientific problems of engineering work. For the type of man which one American school—that at Pennsylvania—aims at turning out there is also a demand here, but only a limited one in number, and these men can, if of the right type personally, go straight from college.

Finally, I would submit that, in the limited time a man is at college, and taking into account what has been said above concerning the "average engineer," the present education, while certainly not beyond criticism, does meet an "average demand."

King's College, December 2nd. S. J. DAVIES.

PROGRESS MEN IN SMALL WORKS.

SIR,—I have been struggling for some time to reach a decision about the employment of a progress man. Some of my friends say that he makes all the difference, even in a small works, but others tell me that the cost of maintaining him with his staff and equipment is greater than anything he can save.

After balancing up the *pros* and *cons*, it seems to stand like this. If a works is paying £2000 per week in wages and about £3000 on material, then a progress man may be worth while, even if he does cost about £10 or £12 a week all told. But in a small works whose total bill for labour and material is about £500 per week, I cannot see that a progress man is likely to save enough to pay his expenses. After all, the manager is supposed to keep his eye on the progress of work through the shops, and the employer himself is not quite a negligible quantity, although nowadays he spends most of his time chasing orders.

What I want to know is what (1) a progress man really does cost? (2) What saving he can make in a works doing general engineering in a rather small way? I am told I could get a man for £6 a week, and that the total expenses should not exceed £8 per week. At present my net profits are often not even £80 a week. Unless my progress man can raise them to at least £90 he is hardly worth it.

I take great interest in these problems because I like to be up to date and, as you must have amongst your readers some like myself, I should be glad to know their experience. Please do not give my name or address, as I do not want to see any more progress men till I know where I am.

December 6th. J. S.

CORROSION AND BOILER FEED.

SIR,—In your report of the discussion on Mr. J. Anderson's paper given at the autumn meeting of the Institute of Fuel, it would appear that I stated we had no corrosion trouble with a feed-water oxygen content of 0·2 c.c. to 0·5 c.c. per litre. What I said was to the effect that during the period in which we experienced corrosion troubles, the above values were representative of our feed-water oxygen contents. To ensure against corrosion, we endeavour to maintain less than 0·1 c.c. of oxygen per litre, and, in addition, carry a definite alkalinity in the boiler feed water.

JOHN BRUCE.

Barking, December 3rd.

SIXTY YEARS AGO.

THE congestion of traffic in the streets of London is no new problem. It existed in the days of Charles II., and sixty years ago the problem of providing relief for it had reached an acute stage. Writing in our issue of December 6th, 1867, Mr. P. W. Barlow, the well-known engineer, described the condition of London as that of a city so densely crowded with public buildings, offices, shops and warehouses that those who occupied them could not approach their places of business without mutual interference and loss of time. The construction of the first portions of the Underground Railway had afforded a certain amount of relief, but the growth of traffic had speedily renewed the congestion in the streets. Parliament took action and passed a Bill for the better regulation of the traffic. The real difficulty, however, lay in the narrowness of the streets. The time was not ripe for the large and expensive schemes of reconstruction and the driving of new streets, which have since been carried out; but already people, among them Mr. Barlow, were turning their attention to the possibility of diverting much of the traffic below ground. The horse-drawn omnibuses of the day were responsible for much of the congestion, and it was to their replacement by a system of underground tubes provided with rails for the passage of omnibuses that Mr. Barlow invited consideration. The proposals sketched contained the elements of our modern tube railway system, except in so far that they of necessity omitted all mention of electric propulsion. The tubes were to be driven by means of a shield, and were to be lined with cast iron. The shield was to be propelled by hydraulic power into the London clay. The tunnel was to be 8ft. in diameter, and was to dip between stations to provide the acceleration and retardation required at the beginning and end of the journeys. The carriages to be employed on this subway omnibus system were to be made of steel plates. Lifts were to be provided to convey the passengers to and from the surface, and it was specified that in order to save space on the surface the passengers were to obtain their tickets underground. When we consider that street tramways of the horse-drawn variety were then just being introduced from America in one or two European cities, this proposal for underground passenger tubes appears bold and anticipatory. As in many other instances of schemes proposed in the mid-Victorian epoch, we find that this one presented a remarkable blend of modern ideas and crudeness. The omnibuses, according to Mr. Barlow, were not to be hauled by horses but were to be propelled by human power! He had satisfied himself by calculations, which we must confess we cannot follow, that an omnibus with twelve passengers could be propelled comfortably and without fatigue through the proposed subway by two men.

The Smithfield Club Show.

WE were delighted, on visiting the Smithfield Club Show, which opened in the Agricultural Hall, Islington, on Monday last, December 5th, and closes to-day, to find that among the machinery exhibits there really were a few novelties to chronicle. Within recent years there has, as we have annually complained, been such a sameness in these exhibits at the Agricultural Hall that it has been difficult to justify any further reference to the various stands. This year, however, it must have struck the careful observer that our agricultural engineering firms are endeavouring to "break new ground," and that there is an increasing tendency to utilise oil or petrol engines in the place of steam machinery. We did not, however, discover in the course of a careful scrutiny of the Show much indication of any tendency towards general adoption of the electrification of farms on which the Electricity Commissioners appear to have based so many hopes. Rather, one is led to the belief that electricity will come into our farms from local, independent sources, that internal combustion engines will become more popular for comparatively light services, and that steam engines still hold the field for really hard work on the land.

Of those steam engines, such as those exhibited by Wm. Allchin, Aveling and Porter, Charles Burrell and Sons, John Fowler and Co., Wm. Foster and Co., and some others, little need be said, as the mere mention of their names is an indication of what the visitor may expect to find on their stands; but there are those few novelties at the Show—they may not be complete novelties, but they were novelties

FIG. 1—MACHINE FOR PLUCKING BIRDS—BENTALL

at the Show—which we happened to encounter. They amount to the several items which we illustrate: a machine for plucking the feathers off a dead bird, a new design of hopper-cooled oil engine, a petrol-driven shunting locomotive, a forced feed lubricator, a six-wheel lorry, and a ploughing tackle driven by a high-speed heavy oil engine.

Taking these items in rotation, the first machine, by E. H. Bentall and Co., of Maldon, Essex, is illustrated in Fig. 1 and comprises a rotating plucking device whereby a series of blunt blades pass across the blunt edge of a sprung shoe. At the actual plucking point there is a small grid, and a large-diameter fan is mounted on the same spindle to draw a steady draught of air through the plucking device. The operation of plucking the bird is extremely simple. It is held against the grid when the draught draws the feathers across the stationary shoe. The rotating blunt blades coming down between the shoe and the grid pluck the feathers from the bird and sweep them round across the surface of the sprung shoe, when the draught from the fan picks them up and delivers them to a sack hanging on the fan outlet. With this machine rough plucking can be carried out at an extraordinary speed, varying naturally with the experience of the operator and the condition of the birds, but approximately fifty birds can be plucked in an hour. The machine can be driven either by electric motor or by a small petrol or paraffin engine, and the cost of operation is said to be in the neighbourhood of 2½d. to 4d. per hour. One very great advantage of the machine is that the feathers are packed directly and partially dried. Experience shows that the flesh is not bruised in any way, nor the skin torn. It is probable that this machine will have a very large market among poultry farmers and in the big poultry establishments.

The second item of our list, the oil engine shown in Fig. 2, is by Blackstone and Co., Ltd., of Stamford, and is of the hopper-cooled type. That is to say, it does not require any piping connections for the jacket cooling water, as the hopper contains sufficient water to keep the engine cool during all ordinary runs of work. The engine is of 10 horse-power and runs at 450 revolutions per minute. Its valve gear embodies the spring injection principle, which we have already described in connection with other engines made by this firm, and it will start from cold and run on the lighter fuel oils or paraffin. The unit is generally mounted on stout wood skids so that it may be readily hauled about from job to job on rough

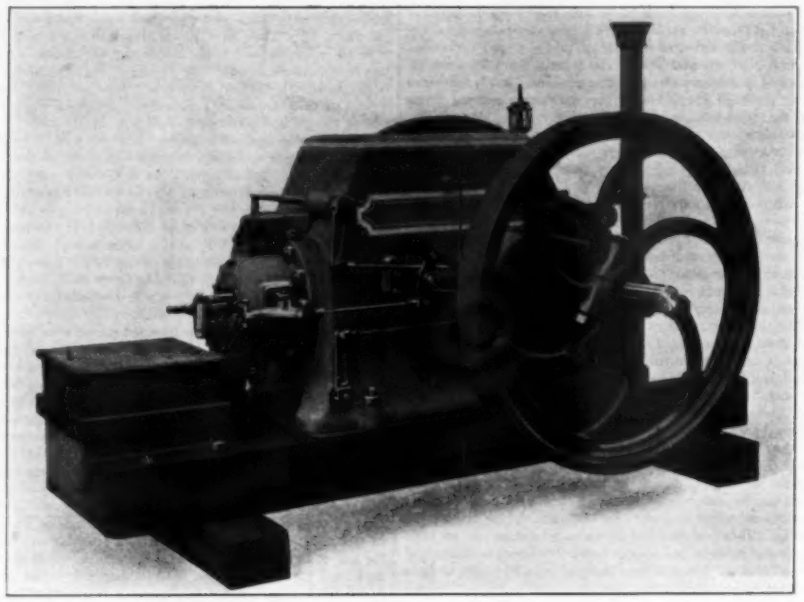


FIG. 2—10 H.P. HOPPER-COOLED OIL ENGINE—BLACKSTONE

ground. On the same stand there are also some other oil and petrol engines, together with some milling plant and agricultural implements.

As to the petrol shunting locomotive, by J. Fowler and Co., Ltd., of Leeds, shown in Fig. 3, we gave a brief description of the machine in connection with the Public Works, Roads and Transport Exhibition in our issue of December 2nd, and consequently need say nothing more about it here. There are also on this stand a compound steam ploughing engine of the cable type, a 70 horse-power Diesel engine similar to those fitted in the company's oil-driven ploughing tackle, a 6–7 ton three way tipping steam wagon and some cultivating gear.

On the stand of Petters Ltd., Yeovil, one usually

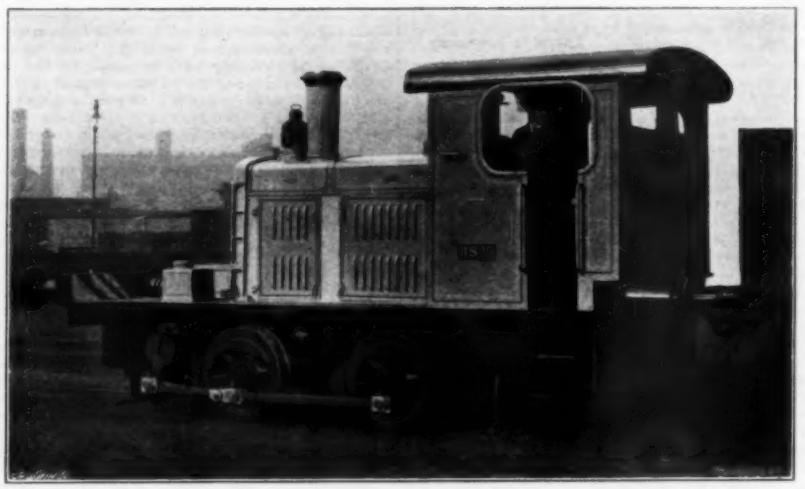


FIG. 3—PETROL SHUNTING ENGINE—FOWLER

expects to find just the familiar range of oil and petrol engines for which this firm can justly be termed, even in the language of THE ENGINEER, as being "famous," but on this occasion there is the novelty illustrated in Fig. 4. It is a forced feed, sight-feed lubricator with two pumping plungers, one to suck up the oil and deliver it to the sight feed and the other to drive the oil to its ultimate destination. The lubricator consists of an oil supply tank which is fitted with a gauge glass to show the amount of oil it contains, and a couple of independent pump units, which are driven by means of one cam shaft. This cam shaft is driven through the medium of a ratchet and pawl mechanism, and the drive for this is obtained through an adjustable lever from any suitable point on the engine or machine. Each pump unit consists of a phosphor-bronze pump body in which there operate two hardened steel plungers. These plungers are provided with a sheave which partially encircles the cam or excentric in such a manner that the pump can be readily lifted clear for dismantling purposes. By slacking off two nuts the complete pump unit may be lifted clear of the tank and cam shaft. The two pump plungers, measuring and delivery, are glandless; they have long stems hardened and ground to fine limits, and provided with oil sealing rings. It will be noticed that one of the plungers is in one piece with the sheave, while the other is attached by a free-fitting collar so that the two plungers can be properly ground and are adaptable to the spacing of the bores. The valves are not of the ball-and-spring type, which, the makers consider, have been found to give trouble through sticking or leaking, on account of foreign matter lodging in their seatings, but consist of accurately fitted plungers in the same barrels of the pump body as the pump plungers themselves. The valves have a simple reciprocating movement without any twisting or oscillating, and no side thrust is developed.

Referring to Fig. 4, A shows the pump body, B the cam shaft, C and D the delivery and measuring pump plungers, E the cam shaft sheave, F the measuring plunger valve, G the delivery plunger valve. The operation of the pump unit is as follows:—The oil from the pot container enters through the strainer H into the passage I leading to the suction pump chamber J. Movement of the suction pump plunger forces the charge of oil towards the passage-way K against the spring-loaded valve plunger F. When the passage K is uncovered the charge is pumped up to the sight feed M and falls into the passage-way N. From there it enters the delivery pump chamber O, and on the next stroke of the pump plungers is forced up through the delivery pipe P to the bearings. It will thus be seen that the valves are really piston valves, and are of a very simple and reliable type with which it is impossible to have trouble. The adjusting screw operates

in the following way:—When it is screwed in the measuring pump valve plunger is allowed to approach the pump plunger, thus reducing the volume of the space in the pump which is occupied by the charge of oil. This volume represents the amount of oil which is pumped at each stroke, and with the adjusting screw in, therefore, the oil delivery will be reduced. Any possible leakage of the oil from the valves consequently has no effect on the cleanliness of the lubricator, as all the mechanism is enclosed in the pump body and submerged in oil. A large strainer is fitted to the filler cap of the tank in addition to the small strainers fitted to each pump suction.

We have in the past described the Garrett steam lorry so thoroughly that it is unnecessary to enlarge upon its general design here, but the example shown,

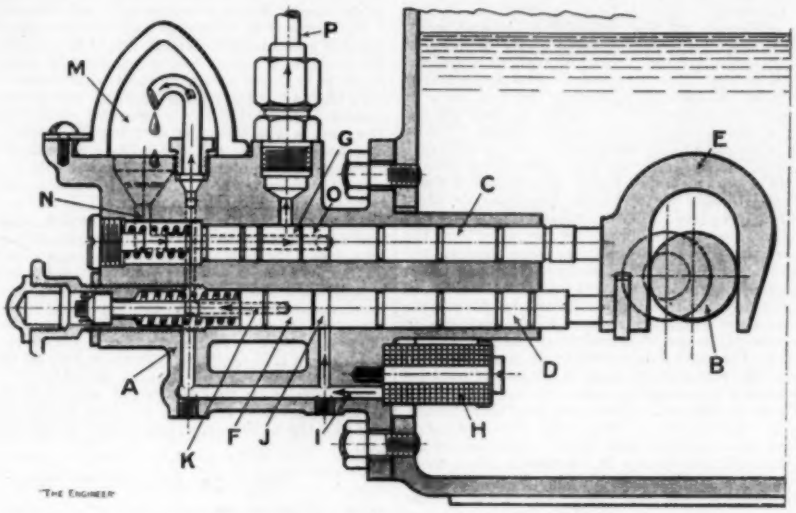


FIG. 4—FORCED-FEED, SIGHT-FEED LUBRICATOR—PETTERS

which is illustrated by Fig. 5—is novel in that it has six wheels. The engine and boiler are normal, but the engine has been brought a little further back than in the four-wheel design, in order to distribute the weight more evenly. It drives the transverse countershaft, which includes the differential gear, directly, and the whole arrangement forms a unit, suspended at three points, that can be readily detached from the main frame for overhauling. From the countershaft roller chains drive the front pair of back wheels and the two pairs of wheels are connected together by other chains. The two axles are carried by a spring frame which can rock about the centre point to equalise the load on the four wheels, and the whole assembly can be dismantled as one unit. In going round curves there is,

FIG. 5—SIX-WHEELED STEAM LORRY—GARRETT

naturally, a tendency for the back wheels to slip slightly, but it is no more than the rubber tires will accommodate readily. It will be noticed that in the photograph which we reproduce there is a linked steel band round the rear wheels, but as a matter of fact the machine shown at the Agricultural Hall is not equipped with this device. These bands are merely slipped over the wheels. They are of great assistance in negotiating soft routes, and, we understand, are not detrimental to the rubber tires. The load-carrying capacity of these machines is 10 tons, and their tare weight is about 9 tons. The normal speed is 12 miles per hour, the overall length 26ft. 9in. and the width 7ft. 3½in.

The ploughing engine, by J. and H. McLaren, of Leeds—illustrated in Fig. 6—is very familiar in general appearance, but is this year notable on account of the fact that it is driven by a high-speed Diesel engine in place of the normal petrol engine formerly adopted. The new engine is made in Leeds, and runs at a comparatively high speed, but has the characteristic that it can be throttled down to quite a low speed, and will still fire consistently on each of the four cylinders, so that the full-speed torque is maintained. The merits of this peculiarity for ploughing service, where the implement must be slowed up in turning the headlands, needs no emphasis.

The exhibits of Crossley Brothers, of Openshaw, Manchester, comprise a range of small oil engines and the oil-driven pumping set illustrated in Fig. 7. This set, it will be seen, embodies a hopper-cooled engine directly geared with a double-acting piston pump. The gear wheels, by the way, are all machine cut. The machine exhibited is capable of delivering 500 gallons per hour, and is driven by an engine of 2 horse-power, the general characteristics of which we have described in connection with past Shows at the Agricultural Hall. It has a bore of 3in., with a stroke of 5in. There are also two other models with outputs of 1000 gallons and 1500 gallons per hour, with correspondingly larger pumps. The intermediate size is driven by a 2 H.P. engine, while the largest has a 3 H.P. drive.

Of the exhibits on the stand of Clayton and Shuttleworth, Ltd., Lincoln, little need be said, as they are familiar to visitors to the Show. They comprise a 6-ton overtype steam wagon, a 4ft. 6in. thrashing machine, a chaff cutter, and a 30 H.P. cold starting oil engine. The latter is the most novel of the machines, as it is a new, smaller edition of the engine which we have already described most recently in connection with a Somerset quarry job in our issue of May 20th last. It appeared to us that for a horizontal two-stroke engine, this one occupies an unusually small amount of floor space. It is claimed by the makers that this engine will run on practically any brand of heavy residual oil or refined oil, at an expense of ¼d. per brake horse-power per hour, at the present cost of fuel oils. The 30 horse-power engine runs at 320 revolutions per minute.

The chaff cutter, to which we have already referred as being exhibited on this stand, is chiefly noteworthy on account of the adoption of a channel steel underframe, in the place of the more usual wooden framing, which was liable to cause trouble through breaking during transport on the road. The gear wheels are all arranged in a self-contained casing, so that their alignment does not depend upon the rigidity of the frame work. The bagging elevator on the new machine is so arranged that it need not be folded back for travelling, and the overall dimensions of the machine are not exceeded, so that it may be easily manœuvred through gates or other restricted passages.

Ruston and Hornsby, Ltd., of Lincoln, have two adjacent stands, one of which is devoted to agricultural implements, while the other bears a variety of oil engines and pumping plant. There are, for instance, engines of 1½, 2½, 4 and 6 horse-power of the petrol-paraffin type, with hopper cooling systems, and some larger medium-compression four-stroke sets, with ordinary jacket cooling. The pumps are of both the ram and the centrifugal types, some of them being directly driven by oil engines.

Of the exhibits on the stand of Tangyes Ltd., Birmingham, we propose to deal with only one, as the oil engines, and pumps—of both centrifugal and ram types—are familiar. The exception is a jack intended for motor car and lorry work. It is designed for a

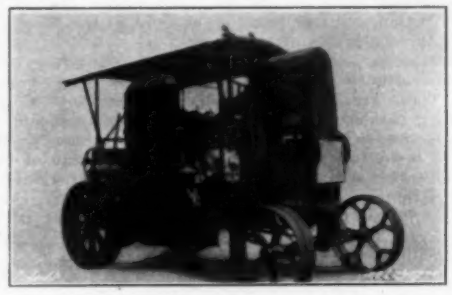


FIG. 6—DIESEL PLOUGHING ENGINE—McLAREN

working load of 2 tons, and is tested up to a load of 2½ tons. The jack is a combination of the hydraulic and screw principles. That is to say, rough adjustments are made by means of a square thread screw, and the final lifting of the load is effected hydraulically. Incidentally, the adoption of the hydraulic principle has the merit, from the motorist's point of view, that it is not necessary to rack the load down again when the jack is finished with. It is only necessary to open the release valve and the load is gently lowered. These jacks have an effective lift, at full load, of 4½in., but have, in addition, a range of 3½in. by means of the screw.

Fodens, Ltd., of Sandbach, are, as usual, exhibiting a steam wagon, but the new model has two distinctive features. It is furnished with electric lamps which are provided with current from a little dynamo driven by a friction wheel bearing against the inside of the fly-wheel flange, and has roller bearings for the crank shaft. We had some conversation with the makers' representative on the subject of these bearings, and while he agreed that in careful hands the ordinary journal bearing is as good as could be wished, the roller bearing has the merit that it will maintain the position of the shaft, and, consequently, the meshing of gear wheels and the clearance of pistons,

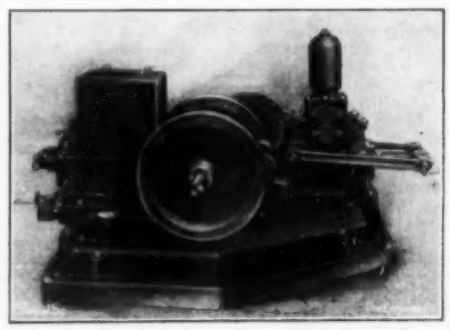


FIG. 7—OIL-DRIVEN PUMP—CROSSLEY

without needing constant attention. It did not seem, in his mind, to be so much a matter of reducing friction as it was a problem of keeping the crank shaft precisely in place when it was in the hands of a careless attendant.

Although the name of Martin's, of Stamford, is familiar in connection with the Shows of the Smithfield Club, their exhibits on this occasion are noteworthy through including some rotary pumps for fire-extinguishing and general purposes. Of rotary pumps there has been such a plethora that it seems unnecessary to enlarge upon the Martin type at the present, as it comprises a rolling motive part revolving in an excentric casing, in which the suction and delivery sides are sealed from one another by a diaphragm; but it is in this diaphragm that we discovered one of the charms of the machine. It is in the form of a fin with a bulbous head, and must be precise in dimensions to the limit of at least one-thousandth of an inch. This diaphragm is being produced by merely cutting off lengths from a stock of extruded metal, and the fit is as much as could be

desired. These rotary pumps, it is claimed, will draw water against a suction head of at least 26ft., and are made in a variety of sizes ranging from 50 gallons per minute up to 500 gallons per minute. We had some most interesting conversation with Mr. Martin as to the constructive details of this pump, and elicited the information that the rotor must be set slightly—how much we must not tell—out of centre, so that when the working pressure comes on the several parts they will not bind together.

The stand of Ransomes, Sims and Jefferies, Ltd., Ipswich, is disappointing in one respect. One expects to find good British machinery there, but this year some of it is assimilated to a Fordson tractor. We have in mind the "Weetrac" tractor plough, which is capable of drawing two furrows to a depth of 8in. The implement, however, would be equally applicable to any other tractor that was servicable for the purpose.

Of the exhibits on the stands of Marshalls, of Gainsborough; of Aveling and Porter, of Rochester; of William Foster and Co., of Lincoln; no description is needed, as they are very much of a pattern with machines exhibited before. The Foster tractor is, nevertheless, noteworthy on account of the adoption of three changes of speed gear, all of which are so interlocked that they cannot be put into gear inadvertently.

There are, of course, many more exhibits in the Show besides those to which we have referred, and no attempt has been made here to cover anything beyond the main hall; and even that, on account of the exigencies of space, has had to be restricted. But we feel that if our engineering manufacturers continue to cultivate the progressive attitude exhibited at the present Show, its successors will be well worth attending.

Canadian Engineering News.

(*From our own Correspondent.*)

Proposed Canadian Railway.

An ambitious scheme, which is being freely discussed in Western Canada at present, is the proposed construction of a railway from the Pacific Coast into the Peace River District of the Province of Alberta.

One of the principal backers of this project is General Frank Sutton, whose financial exploits in British Columbia lately have been almost as sensational as his military ventures as advisor to Chang Tso Lin in China. General Sutton has been touring the Peace River country plotting a tentative route for a railway to connect with the Pacific Great Eastern Railway, which is the Government-owned line in British Columbia. He believes that the proposition is feasible, and he has stated that he will seek financial backing from associates in Great Britain. He has already asked the British Columbia and Alberta Governments for land grants of 20,000 acres a mile. If he is successful in securing adequate financial backing he is prepared to build 150 miles of railway.

Demand for the building of a coast outlet for the Peace River District is insistent in British Columbia, and steps are being taken by the provincial authorities to enlist the co-operation of the Dominion Government. The British Columbia Government, while lending an attentive ear to General Sutton's proposals, has not pledged itself to assist him in the venture. The general belief at the coast at present is that the project should be undertaken either by the Canadian Pacific Railway or the Canadian National Railway.

During the last session of the Federal Parliament, the Railways and Canals Committee of the House of Commons, after hearing evidence from engineers who had investigated the possibilities of constructing a railway to the coast, expressed the opinion that building a western outlet from the Peace River area was feasible from an engineering standpoint, but the weight of evidence indicated that, on economic grounds, such construction should not be begun until a further study was made of the matter.

The Peace River area, which is more or less detached from the older settled plains by an intervening belt of rugged territory bordering the Athabasca River, is now experiencing an active era of colonisation and development, such as each successive section of the Canadian Prairie Provinces has witnessed during the past fifty years. Last year ten million bushels of grain were produced in the district, and it was given attention as a superior grain-producing area by honours awarded at the International Grain and Hay Shows at Chicago, for championships in wheat and oats.

Canadian Hydro-Electric Works.

The nineteenth annual report of the Ontario Hydro-electric Power Commission, which controls the activities of the publicly-owned electric power distribution system in the Province of Ontario, Canada, was recently issued, and covers the twelve months' period ended October 31st, 1926. It shows that the generating capcity of the various plants was increased by about 100,000 horse-power during the year.

An interesting fact is that the average cost of electricity to the consumer in Ontario in 1926 was less than two cents per kilowatt-hour. The average cost in the United States to the domestic consumer during the same period was 7·4 cents per kilowatt-hour. More than 80 per cent. of the electrical energy utilised for commercial light service was sold in cities and towns where the average charge to consumers of this class was less than three cents per kilowatt-hour.

Concerning rural electrification, the report states that during the past two or three years very substantial progress has been made in Ontario. Practically all rural electric service is now given through rural power districts, which are operated directly by the provincial hydro commission. There is now more than 4,000,000 dollars invested in the rural power district systems. Towards this rural work the Ontario Government has, in the form of grants-in-aid, contributed 50 per cent. of the costs of transmission lines and equipment, or about 2,000,000 dollars. About 2300 miles of transmission lines have been constructed to date, of which more than 750 miles were approved during the past year.

In order to provide for the immediate future demands for power the Commission during the past year entered into a long-term contract with the Gatineau Power Company, a private enterprise the plants of which are situate on the Gatineau River in the Province of Quebec. The contract calls for 260,000 horse-power. The delivery of the first block of this power is to be made about the end of 1928.

Research in Canada.

Through the joint efforts of the Canadian Department of Trade and Commerce and the National Council for Industrial Research, a plan is being worked out to give to industry in Canada the best results from research work. The proposed plan will combine some of the features of the Mellon Institute and the Bureau of Standards systems in the United States. It is proposed to give public assistance to persons in Canada possessing original ideas or processes for the betterment of industry, and for the furtherance of which they have no private means. Under the Mellon Institute scheme the person with an idea or a process is given the facilities, but if he perfects his process he retains its sole ownership. Under the Bureau of Standards all experiments with private processes or ideas become public property. The proposed Canadian plan would, to a degree, ensure the public the benefits of the experimental work, and at the same time protect the interests of the originator. The Federal Government, at the next session of Parliament, will introduce legislation providing for an appropriation sufficient to place the Dominion on a *per capita* basis of practical equality with other countries which are at present engaged in intensive research work. The most important feature of the proposed expansion will be the establishment at Ottawa of national research laboratories, directly under the control of the National Research Council. The function of these laboratories will be twofold, as follows:—(1) Standardisation work of all kinds, similar to that being conducted by the National Physical Laboratory in England; (2) to make provision for the carrying out of research through the laboratories which will be open to private firms which desire to conduct investigations, under the administration of the permanent staff of the National Council.

A High Frequency Induction Melting Furnace.

At the Autumn Meeting of the Iron and Steel Institute held at Glasgow last September a paper was read on "High Frequency Induction Melting," by Mr. D. F. Campbell, in which he reviewed the early work in connection with induction heating which had been carried out by Kjellin, Frick and Rodenhäusen. In most of these cases low-frequency generators had been used to obtain a reasonable power factor, and they were too expensive and large, while they were also open to the objection that they could not be used for general works purposes in cases of emergency on account of their exceptional periodicity. The author also pointed out that, metallurgically, the ordinary induction furnace had serious limitations. The molten metal was contained in a hearth of complicated form with a large area of refractory material exposed to it, involving high maintenance cost and lack of homogeneity in the metal, while the slag was only melted with difficulty, so that efficient refining was impossible. Another disadvantage of this type of furnace referred to by the author is the necessity to leave or place a quantity of steel in the furnace after each heat to form the secondary connection—a serious drawback when making alloy steels, as the weight of steel cannot be determined with sufficient accuracy to work to close specifications, and the change from one quality to another is difficult.

The use of high-frequency current for melting metals in the laboratory is recognised as one of the most important advances in recent years. Small high-frequency furnaces of the spark type have been used in fairly large numbers in this country. They have been utilised for such purposes as research, platinum melting, and silica ware manufacture. The most important installation of this kind was made by the Telegraph Construction and Maintenance Company, Ltd., which erected forty-six furnaces to make "Mumetal," a new alloy of nickel, iron and other metals, practically free from carbon, which was used for loading the new Pacific cable. The early work of developing these high-frequency furnaces was done by Dr. Northrup, at Princeton University. Since then large units have been built for the steel industry by the Electric Furnace Company, Ltd., which controls Dr. Northrup's patents in Great Britain and elsewhere.

A more recent development of this high-frequency melting is the motor generator type of Ajax-Northrup furnace. A demonstration plant at Bilston was erected by the firm mentioned, and has been in use for melting steel, brass, copper, pure nickel, nickel silver, aluminium, and other metals and alloys. Sheffield University claims to have the first furnace of this type in this country, which, it is true, is only of small capacity, namely, 12 lb., and Dr. Desch states that the consumption of current is remarkably low. Edgar Allen and Co., Ltd., Sheffield, have now adopted the Ajax-Northrup furnace for making tool steel by high frequency on a commercial scale, and we had an opportunity of inspecting this furnace in operation on Tuesday last at the Imperial Steel Works. It may be recalled that Edgar Allen and Co. were the pioneers of the Tropenas acid process for the production of steel castings, and that Monsieur Tropenas perfected his designs in their foundry, where the process is still employed. At these works, too, it is claimed that the first Héroult electric arc furnace in this country began to work, in 1910.

The new plant has a capacity of 450 lb. of steel, which can be melted in about 55 min. with a consumption of current at the rate of 950 units for the first ton and 850 units for each succeeding ton. A 60 lb. crucible furnace heated by gas would, we are informed, require some 2¾ hours to complete the melt, while with coke as fuel the time required would be 3 to 3½ hours approximately. It is claimed, and apparently with justice, that all the advantages of the old crucible process are retained, while no deleterious gases are introduced. The cost of labour and crucibles is far less than with the old process, the temperature control is better, a metal of greater homogeneity is produced, and the process can be intermittent, if desired.

The electrical equipment comprises a 100-kVA single-phase alternating-current motor generator, the power factor of the furnace being corrected by condensers. The voltage of the generator is 1200, and the overall efficiency at full load is 79 per cent. The power factor is between 0·1 and 0·15, depending on the metal being melted and its magnetic properties. The power factor is capable of being corrected up to unity by varying the number of the condensers in the circuit, the condensers adding capacity to the circuit, which neutralises the inductance in the coil.

The furnace is of simple construction, consisting of a crucible surrounded by about 1in. of heat-insulating sand. Around this a helical coil is wound, the temperature of which is kept low by the circulation of water. The spout is on the axis of the tilting trunnion, and the tilting of the furnace is effected either by a motor or by a hand wheel. The coil is the inductor carrying the water and high-frequency current, and the heat is generated within the metal itself inside the crucible, so that the walls merely serve the purpose of a container, no heat being passed from the outside to the contents. This has an important bearing upon the life of the crucible, which, we were told, is much greater than that of an ordinary crucible in which the heat passes through the crucible and wear and tear occurs on the outside. It will be observed that the indicator coil is built into the furnace body, the latter being made of wood in which heat is not generated by induction. The mixing of the contents is more active than usual, owing to the violent stirring due to the electric currents.

Although it would seem that the outlay on the electrical plant is heavy for the amount of material melted, the introducers claim that the power consumption, including all losses, is about the same as in the Héroult arc furnace, and that the extra cost of crucibles is about comparable to that of electrodes.

B.E.S.A. SPECIFICATIONS.

MALLEABLE IRON CASTINGS.

Two specifications for Malleable Iron Castings have just been issued by the British Engineering Standards Association. The principal clauses in the specifications include the provision and size of the test bars, the mechanical tests (tensile and bend) and the machinability of the castings. No chemical composition is specified, as it is considered that the mechanical properties should be regarded as the main requirements, and the chemical composition as an auxiliary check upon the suitability of the material to perform the duties laid upon it. A note, however, is included as to the extreme limits for sulphur and phosphorus which should be present in a good and serviceable material.

The specifications are not applicable to light castings, which are to be subjected to hydraulic, steam or air-pressure tests. Copies of these new specifications (Nos. 309 and 310, 1927) may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each, post free.

THE EFFICIENCY OF ELECTRICAL MACHINERY.

The object of Rules, just issued by the B.E.S.A., is to provide a method of predicting and declaring the efficiency of electrical machines. The use of nominal efficiencies (which omit allowances for stray load losses and other losses) is considered misleading, and is not recognised in these Rules. The Rules point out that the verification of the efficiency of electrical machinery by direct measurement of input and output is unreliable, except when the efficiency is comparatively low, since any errors in measurement cause relatively great errors in the value of the efficiency obtained. The verification of the efficiency by measuring the losses and making due allowances for stray load losses (summation-of-losses method) gives greater accuracy, since an error in the value of the losses causes only a relatively small error in the value of the efficiency obtained. A specification for the methods of verifying efficiency is under consideration; in the meantime, should any question as to the efficiency arise at the time of the acceptance of the machine, the efficiency should be checked in accordance with the method of declaration specified in these Rules.

Apart from its usefulness to the practical engineer, this volume should prove of value to students and others, as it is a comprehensive treatise on the whole question of the efficiency of electrical machinery. The section on definitions is in itself a very useful feature from the student's point of view, apart from the concise schedules of the losses occurring in various types of electrical machines.

It is of interest to note that these Rules have been accepted by the International Electro-technical Commission as the basis for an international volume of Rules on the same subject.

Copies of the Rules which, by the way, do not cover traction motors (Publication No. 269, 1927), may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

Giving evidence before the Royal Commission on the Australian Commonwealth constitution, Colonel Norris G. Bell, the Commissioner of the Commonwealth Railways, advocated the federal control of all the railways in the various states. He said that such a change would simplify the difficulties of obtaining uniformity in freights, fares and gauges, and effect large economies in many directions.

Railway Matters.

IN the autumn of 1921 Mr. Gresley began the use of electric stoves for cooking in the kitchen car on the King's Cross and Leeds dining car train. There are now eight kitchen cars on the London and North-Eastern so fitted. The current is axle generated, supplemented from batteries when the trains are at rest in a station.

THE Postmaster-General has recently stated, on the subject of public telephones at country railway stations, as mentioned herein on November 18th, that the Great Western, London, Midland and Scottish, Cheshire Lines, and Midland and Great Northern Joint railways were co-operating in the scheme. The London and North-Eastern has adopted it with some modifications. So far, 214 stations have been or are being dealt with.

THE Ministry of Transport Tramway Returns, which correspond to the Railway Returns, of capital, receipts, expenditure, &c., for 1926, have now been issued as a Stationery Office publication. They show that, compared with 1925, the number of passenger journeys decreased by 4·47 per cent., and that there was a saving of 2·34 per cent. in the car mileage. The capital invested is £98,610,505 and the net receipts amounted to £4,788,074. It must not be forgotten that 1926 was an abnormal year.

THE "Pennsylvania Limited," the world's first limited train, is just forty-six years old. It first ran on November 19th, 1881, under the name the New York and Chicago Limited. Since its start it has never missed a trip, but has been operated, without interruption, seven days in every week, both east and west-bound. Allowing for leap years, it has therefore completed 33,235 one-way trips between New York and Chicago, representing a distance of approximately 30,000,000 miles. The railway company's statisticians estimate that in this period it has carried more than 6,000,000 passengers.

THE great growth of business and traffic in Northern Ontario, Canada, is indicated by the fact that this year, for the first time, the Temiskaming and Northern Ontario Railway has been able to meet its full interest charges, without any help from the Government. The railway belongs to the Government of Ontario, and this year the Government received from the railway an operating surplus of £260,000. Considering that the railway was built through what was then a forest wilderness, its progress has been as remarkable as the development of the mining and timber wealth which it made accessible.

DURING the ten years that the staff suggestion scheme has been operative on the Underground Railways, many thousands of suggestions have been put forward, and a large proportion adopted. For instance, no fewer than 614 suggestions were received from members of the staff during October last, and in 68 cases awards were made. This latter figure constitutes a record since 1920, when in May of that year 71 awards were made. As an example of the stimulating effect of the scheme, it may be mentioned that an electrical fitter stationed at the Acton works has received as many as six awards during the past twelve months, and has, accordingly, been granted a special bonus, in addition to the individual awards made in recognition of his efforts.

AN important deputation waited upon the Minister of Transport on November 22nd to urge that increased assistance should be given from the Road Fund for the reconstruction of over-railway and canal bridges upon which loads are now limited. Colonel Ashley said that the Ministry appreciated the magnitude and importance of the problem, and understood how detrimental the existence of such weak links in the highway system must be to industry and commerce. He was prepared to consider applications for assistance from the Road Fund in individual and urgent cases, and if general agreement could be reached as to legislation to meet the general question, he would do what he could to further the early introduction of the necessary measure.

THE construction of a railway, 85 miles in length, to serve the mining region north of the Pas. Manitoba has been secured by an agreement between the Governments of Manitoba and the Dominion, under which the line will be built by the Canadian National Railways as a part of their system. The Manitoba Government agrees to guarantee to pay an amount not exceeding 100,000 dollars annually for a period of five years, to make good any deficits which may occur in the operation of the line during that period. The Whitney interests, which are developing the Flin Flon copper property, where the ore blocked out or indicated is estimated at a value of 200,000,000 dollars, have agreed to contribute 250,000 dollars towards the cost of the railway, to secure the building of the line without delay, and will also undertake to build a smelter on their property with a capacity of 2000 tons of ore per day, and also to proceed with a large water power development. It is estimated that the railway will cost approximately 3,500,000 dollars. The line will extend north from mile 8 on the Hudson Bay Railway to the Flin Flon property.

AS the agenda for the next International Labour Congress includes a reference to automatic couplings as a means of preventing accidents to railway servants, it may serve a good purpose if it is stated that we find that during the five years 1922–26 there were twenty-eight fatal and 1993 non-fatal accidents in coupling and uncoupling on British railways; the respective averages for those figures are 5·6 and 398·6 per annum. In contrast to the accidents in this country, where automatic couplings are the exception, there were in one year, in the United States, where automatic couplings are compulsory and universal, 151 killed and 2450 injured in coupling accidents. Shunters have the most dangerous occupation on a railway in this country, and during the same five years there were 91 of them killed and 3672 injured in every class of movement accident, or an average of 18·2 killed and 734·4 injured each year. In the United States, in the same one year, there were 78 brakesmen killed and 1469 injured in coupling accidents alone. The proportion of shunters killed was 1 in every 1000 killed and 1 in every 24·6 injured in all movement accidents, and of brakesmen the proportion killed in coupling accidents alone was 1 in every 150 and 1 in every 5 injured.

Notes and Memoranda.

THE "selective flotation" method of concentrating ores, which was first introduced in the United States in 1921, and is said to be working a veritable revolution in the copper, lead and zinc industries, is to be the subject of a special study by the American Bureau of Metal Statistics. Data showing the extent to which this process has been adopted and the output of ores resulting from its use in the United States will be collected by the Bureau and made the basis of its report, which, it is anticipated, should be completed in two or three months. In addition to copper, lead and zinc, the metals affected in some degree by the new process include gold, silver and molybdenum.

IT is reported that the Municipal Council of Paris has decided to adopt the scheme of urban central heating which was recently proposed, and by which the buildings in a whole district will be heated from a central station and not by separate installations. The work has been entrusted to a private contractor, who has undertaken to begin the installation within one year and to lay at least 6 kiloms. (3·7 miles) of mains, which will supply heat to 7000 flats, within five years. The cost of the mains is estimated at about 8,000,000f. (£64,000) per kilometre. The pipes will be laid in tunnels, so as to facilitate repairs, and gas, electric and water mains will probably be transferred to the same tunnels, so that in the future interference with traffic will be reduced. The derelict power station of the Metropolitan Railway on the Quai de la Rapée will be the boiler-house of the first system, which will extend to the Opéra quarter.

ARRANGEMENTS are being made for extensive development of the large deposit of molybdenite at Lake Malartic, south of Amos, Quebec. By the spring regular shipments of pure molybdenite are expected to be sent down the Harricanaw River. Molybdenite is a sulphide of molybdenum, a metal which was not in great demand prior to the world war, when it came into extensive use for hardening armour plate and in the manufacture of various munitions. Its uses in industry are now constantly growing, particularly in the manufacture of special steel alloys, molybdenum steel possessing exceptional strength and toughness suiting it for use in the automobile industry, for manufacture of boiler plates, grinding mills, &c. The mineral is found in many sections of Canada, but has not so far been extensively developed, production in 1926 being reported at 25,168 lb. of molybdenum concentrates, containing 20,934 lb. of molybdenum sulphide, valued at 10,472 dollars.

IMPORTANT developments in communications between nautical wireless stations on land and ships at sea are to be carried out by Post Office engineers. Opportunity has presented itself by the recent transference of the nautical wireless station at Grimsby to Mablethorpe in Lincolnshire, where many interesting features will be incorporated. In course of time these will be adopted by the six other stations situated in various parts of England and Scotland. They include a valve transmitting apparatus working on the "interrupted continuous wave system." Chief interest, however, centres around the intention of the engineers to arrange for telephonic communication between the station and ships equipped with radio-telephony apparatus. In view of the comparatively restricted range of the nautical stations, the ships which will derive most benefit from the innovation will be small coasters. The service, however, which will be available to the public, holds infinite possibilities for future development.

A NEW method of teaching the deaf to speak, which promises to simplify that extremely difficult task, is being put to a practical test in a series of experiments conducted at the Western Pennsylvania School for the Deaf, in Edgewood, Pennsylvania, United States of America. The new method is known as "voice vision," and is based on a recent invention which presents the voice in a visible form by transforming sound waves into light waves. The teacher speaks a sustained note, such as "ah" or "oh," into a telephone receiver attached to the "Osiso," and the child watches the path of the light waves, and, by experimenting with his voice, soon reproduces approximately the same picture as the teacher, which means approximately the same sound. The "Osiso" is the invention of Mr. Joseph W. Legg, an engineer of the Westinghouse Electric and Manufacturing Company. When sound waves strike the diaphragm of the receiver, currents of exactly the same frequency are set up in an electric circuit, causing a small mirror to vibrate, with the result that a narrow beam of reflected light traces a path similar to the wave-form of the sounds; by means of a rotating polygon of mirrors, the light wave is made to appear in the form of an unbroken wave.

IT is reported that steps are to be taken to carry out chemical and biological investigations regarding the river Tees with the object of making these investigations the basis of a test for other rivers of the country. In his statement to the Tees Fishery Board, Lord Gainford says that the area of the Tees from Yarm to the estuary made it ideal for such a test, as the investigators would be able to deal not only with effluents from works, but also sewage pollution from Middlesbrough and Stockton. Last July the Tees Fishery Board made an application to the Scientific Research Department for financial help in investigating the question, and a reply was received to the effect that the Department was going to concentrate on the Tees because that river was the worst for pollution, and the results obtained would be valuable in dealing with other rivers. The Department called attention to the fact that the Tees Fishery Board was already carrying out investigations in conjunction with a Committee representing the works on the river, and asked that a scheme should be formulated for extending this work. If that were done it would be prepared to consider sympathetically the question of financial aid. At the same time, it was added that most of the funds would have to be raised locally. The Tees Fishery Board has now passed a resolution in favour of making the Tees a test river, and is to invite representatives not only of the works, but of the towns on the river to co-operate in accordance with the wishes of the Department.

Miscellanea.

FOUR new steamship berths and an elevator of 2,000,000 bushels capacity are to be constructed at St. John, New Brunswick.

A PLANT for distilling wood is being put up at Borschum, South Russia. It will be capable of producing 50,000 kilos. of wood creosote annually.

EARLY in the New Year the Anglo-American Oil Company intends to utilise ground at Tweedmouth Dock for the purpose of building a large oil depôt.

LLOYD'S Register of Shipping has published a new set of rules for the building and classification of composite and steel yachts of the cruising type.

THE picture telegraph service between Vienna and Berlin was formally opened on the morning of December 1st with the interchange of photographs of the Austrian and German Chancellors. The lowest tariff for a picture measuring 10 cm. by 4 cm. is 8s. That works out at 2·4d. per square centimetre, or about 1s. 3½d. per square inch.

THE Secretary for Mines announces that he has appointed a Committee to report to the Safety in Mines Research Board from time to time on what research is required for the improvement of mine rescue apparatus and equipment, and how such work should be carried out, and as a Committee of the Board, to co-ordinate research on this subject and to superintend any special research that the Board may undertake to carry out by its own investigators.

BECAUSE of the growth of telephone traffic in the London toll area, a new toll exchange has been opened at the G.P.O. (South), Carter-lane, E.C. The old exchange will deal with incoming traffic from the toll area of London, while the new exchange will deal with all traffic from London. With the increased facilities thus provided it has been possible to include Southend-on-Sea, Leigh-on-Sea, Aldershot, Chatham, Camberley, and Horsham in the toll area, and callers for these places should now ask for "tolls" instead of "trunks."

THE extension of the administrative buildings of the Tempelhofer Flughafen, Berlin's aerodrome, is now in progress. In the spring work will begin on the starting field, which will have a new concrete elliptical starting track, 900 m. across from north to south, and 1200 m. from east to west. The track will be some 20 m. wide, and is expected to be completed in the early summer. The first intention was to have a circular track, but the elliptical shape was adopted as the general direction of the wind is from east or west. The concrete track is expected to result in considerable saving in the cost of upkeep of the starting field.

THE first of the three final sections of the 50,000 tons floating dock for the new naval base at Singapore was successfully launched on Wednesday afternoon at the Wallsend shipyard of the builders, Swan, Hunter and Wigham Richardson, Ltd., and the remaining two sections will be launched within the course of a few days. During the next few months the seven sections comprising the whole dock will be tested and joined together in two main sections for the long voyage to Singapore, which will entail a tow of 8500 miles, including the passage of the Suez Canal. The structure will contain over 3,000,000 rivets and about 20,000 tons of steel. Rivets have been put into the dock as rapidly as 130,000 in a single working week.

THE authorities of Havre have for some time been discussing the growing need of better means of communication between that port and Honfleur, which is on the opposite side of the mouth of the Seine, than can be provided by small ferry steamers. There was talk of a motor ferry for vehicles, but there were found to be various difficulties in the way of that solution. A plan has now been sent to Monsieur Tardieu, Minister of Public Works, for the construction of a tunnel, which provides for a roadway 20ft. wide and a quarter of a mile long under the bed of the Seine, at a sufficient depth to allow of further dredging of the river, if necessary. The expenditure, including the approaches, is estimated at 25 million francs —£200,000—plus seven million gold marks—£350,000— for materials. The work could, it is estimated, be completed in three years.

IMPORTANT developments are expected to follow the taking over of the plant of the Lignite Utilisation Board at Bienfait, in the province of Saskatchewan, Canada, by the reorganised Western Dominion Collieries Company, of Winnipeg, with additional British capital. It is the company's intention to remodel the plant for commercial operations at the earliest possible date. This arrangement brings to a successful conclusion negotiations which have been in progress for some years. In 1918 the Lignite Utilisation Board was formed to devise a means of utilising the lignite which occurs in Eastern Saskatchewan and Manitoba, which is the only fuel of those areas, but which falls to pieces when mined and hence has only a restricted use. Enormous supplies of this fuel are available in those sections. A process for the practical production of a carbonised lignite briquette for domestic consumption has been found.

TENDERS will shortly be invited by the Venezuelan Ministry of Public Works for extensive improvements in the water and sewerage system of Caracas. For some time a study of the watershed of the region north and west of Caracas has been in progress, with the object of establishing new reservoirs to provide a larger water supply for the town and suburbs. The present supply is derived from the river Macarao, at a point about 15 miles west of the town, the water being conveyed by an aqueduct to a reservoir on the El Calvario Hill, the filtration plant being in the valley. The municipality wishes to improve these arrangements and at the same time obtain a further supply from small streams from the slopes of the coast range. The plans also call for the reconstruction of the Rio Macarao aqueduct. Modern concrete piping will be installed. Owners of houses not at present connected up will be compelled to install tanks and built-in cisterns large enough to collect water during the night for use the following day. Householders must also provide high tanks for baths and toilet purposes.

THE SHANNON HYDRO-ELECTRIC POWER SCHEME—CAMPS AND BUILDINGS

THE SIEMENS-SCHUCKERT COMPANY, BERLIN, ENGINEERS

(*For description see page 646*)

FIG. 20—GENERAL VIEW OF WORKS BUILDINGS

FIG. 21—GERMAN CAMP AT ARDNACRUSHA

FIG. 22—WOODEN HOUSES FOR GERMAN STAFF AND WORKPEOPLE

FIG. 23—STREET IN IRISH CAMP

The Engineer
Annual Subscription Rates
(Including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below:

BRITISH ISLES	£3 6 0	
CANADA	£3 3 0	Thick Paper edition.
	£2 18 6	Thin Paper edition.
ABROAD (except Canada)	£3 7 6	Thick Paper edition.
	£3 3 0	Thin Paper edition.

AFRICA	Central News Agency. All Branches	
* £3 7s. 6d.	CAPE TOWN: Wm. Dawson and Sons, Ltd.,	
† £3 3s. 0d.	29–31, Long-street (Box 489)	
	JOHANNESBURG: C. Juta and Co.	
ARGENTINA	BUENOS AIRES: Mitchell's Book Store, 576,	
* £3 7s. 6d.	Cangallo	
† £3 3s. 0d.		
AUSTRALIA	Gordon and Gotch (Australasia), Ltd. All	
* £3 7s. 6d.	Branches	
† £3 3s. 0d.	MELBOURNE: Robertson and Mullens,	
	Elizabeth-street	
BELGIUM	BRUXELLES: W. H. Smith and Son, 78–80,	
* Fr. 590	Rue du Marché-aux-Herbes	
† Fr. 550		
CANADA	American News Company, Ltd. All Branches	
* $15·25	MONTREAL: Gordon and Gotch, Ltd., 934,	
† $14·25	Notre Dame-street, W.	
	TORONTO: Wm. Dawson and Sons, Ltd., 87,	
	Queen-street East	
	TORONTO: Gordon and Gotch, Ltd., 45,	
	Richmond-street, E.	
CEYLON	COLOMBO: Wijayartna and Co.	
* Rs. 44·5		
† Rs. 41·5		
CHINA	HONG KONG: Kelly and Walsh, Ltd.	
* $37	SHANGHAI: Kelly and Walsh, Ltd.	
† $34·5		
EGYPT	CAIRO: Express Book and Stationery Store,	
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi	
† £3 3s. 0d. (Pt. 308)		
FINLAND	HELSINGFORS: Akademiska Bokhandeln,	
* M. 650	Alexandersgatan, 7	
† M. 605		
FRANCE	PARIS: Boyveau and Chevillet, Rue de la	
* Fr. 418	Banque, 22	
† Fr. 390	PARIS: Berger Leverault, 229, Bld. St.	
	Germain	
	PARIS: Brentano's, 37, Av. de l'Opera	
	PARIS: Dunod, 92, Rue Bonaparte	
GERMANY	BERLIN: H. Hermanns, Friedrichstrasse 218,	
* R. mks. 70·00	S.W. 48	
† R. mks. 65·00	WESTERN GERMANY: Fritz Rehfus, Blumen-	
	thalstrasse 10, Cologne	
	LEIPZIG: K. W. Hiersemann, Konigstrasse 29	
HOLLAND	ROTTERDAM: Hector's Boekhandel, Noord-	
* Fl. 41·00	blaak 59	
† Fl. 38·00	ROTTERDAM: Techn. Boekhandel, "Plan C,"	
	Gelderschestraat 4	
INDIA	BOMBAY: Thacker and Co., Ltd.	
* Rs. 45	CALCUTTA: Thacker, Spink and Co.	
† Rs. 42		
ITALY	MILAN: Ulrico Hoepli	
* Lire 300	ROME: Maglioni and Strini, 307, Corso	
† Lire 280	ROME: Fratelli Treves, Corso Umberto 1,	
	174	
	ROME: Fratelli Bocca	
JAPAN	Maruzen Co., all Branches	
* £3 7s. 6d.		
† £3 3s. 0d.		
JAMAICA	KINGSTON: Educational Supply Co.	
* £3 7s. 6d.		
† £3 3s. 0d.		
NEW ZEALAND	AUCKLAND: Whitcombe and Tombs, Ltd.	
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches	
† £3 3s. 0d.	NAPIER: J. Wilson Craig and Co.	
RUSSIA	LENINGRAD: Mezhdunarodnaya Kniga, Pros-	
* £3 7s. 6d.	pect Volodarsky, 53 A	
† £3 3s. 0d.	MOSCOW: "Litiedat," Kouznetsky Most, 5–15	
STRAITS SETTLEMENTS	SINGAPORE: Kelly and Walsh	
* $29·25	Ltd.	
† $27·25		
SWEDEN	STOCKHOLM: A/B Wennergrens Journal-	
* Kr. 61·00	expedition, Stockholm 1	
† Kr. 57·00	STOCKHOLM: A/B C. E. Fritzes Kungl.,	
	Hofbokhandel, Fredsgatan, 2	
SWITZERLAND	BERNE: Joh. William De Groot, Laupenstr. 5	
* Fr. 85·20	ZURICH: Rosa Leibowicz, 4, Ankerstr.	
† Fr. 79·50		
UNITED STATES OF AMERICA	International News Co. All Branches	
* $16·40		
† $15·25		

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 0d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Telegr. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. Central 2250, 2257.

By arrangement with Reuter's Engineering Service, The Engineer contains the latest news from all parts of the world which is likely to be of interest to engineers.

Contents.

THE ENGINEER, December 9th, 1927.	PAGE
A SEVEN-DAY JOURNAL	645
THE SHANNON POWER SCHEME. No. II. (Illus.)	646
RECENT PROGRESS IN THE METHODS OF CITY REFUSE COLLECTION. No. I.	648
THE CENTENARY OF ALUMINIUM	649
INSTITUTION OF MECHANICAL ENGINEERS. (Illus.)	650
AUTOMATIC LIQUID ANALYSIS	652
SAFETY IN FACTORIES	652
LETTERS TO THE EDITOR—	
Compounds on Rail and Sea	652
The Springing of Locomotives	653
The Economics of Speed	653
The Man and the Job	653
Progress Men in Small Works	653
Corrosion and Boiler Feed	653
SIXTY YEARS AGO	653
THE SMITHFIELD CLUB SHOW. (Illus.)	654
CANADIAN ENGINEERING NEWS	656
A HIGH FREQUENCY INDUCTION MELTING FURNACE	656
B.E.S.A. SPECIFICATIONS	656
RAILWAY MATTERS	657
NOTES AND MEMORANDA	657
MISCELLANEA	657
LEADING ARTICLES—	
The Comparison of Cutting Tools	659
The Use of Low-grade Fuels	660
LITERATURE	660
TWO IMPROVED WOOD-WORKING MACHINES. (Illus.)	663
INSTITUTION OF MECHANICAL ENGINEERS—NORTH-WESTERN BRANCH	664
A BALANCED WORM GEAR DRIVE FOR SHIP PROPULSION. (Illus.)	665
ELECTRIC PLOUGHING	665
AN IMPROVED ELECTRO-MECHANICAL HAMMER. (Illus.)	666
SOUTH AFRICAN ENGINEERING NOTES	666
PERSONAL AND BUSINESS ANNOUNCEMENTS	666
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	667
Lancashire	667
Sheffield	668
North of England	668
Scotland	669
Wales and Adjoining Counties	669
CURRENT PRICES FOR METALS AND FUELS	670
FRENCH ENGINEERING NOTES	671
BRITISH PATENT SPECIFICATIONS. (Illus.)	671
FORTHCOMING ENGAGEMENTS	672
CONTRACTS	672

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscript: correspondents are therefore requested to keep copies.*

THE ENGINEER.

DECEMBER 9, 1927.

The Comparison of Cutting Tools.

DURING recent years considerable effort has been made to devise some means of judging the merits of a cutting tool without subjecting it to a lengthy and expensive test ending in its destruction. The problem is as complicated as its solution is desirable, and until Mr. E. G. Herbert presented his paper before the Institution of Mechanical Engineers last Friday evening no approach had been made to resolving it. Mr. Herbert, as the account of his paper and the discussion on it appearing elsewhere in this issue will show, has devised what he describes as "a ready means of appraising the merit of high-speed steel tools." By means of his "pendulum" tester and an electric furnace he can carry out hardness tests on metals at elevated temperatures. He proposes, therefore, that to judge the merit of a tool it should be made to show what its hardness is at some selected temperature. Its merits as a cutting instrument would be decided by its attaining or failing to attain a stated "figure of merit," such as 40/600, indicating a hardness of 40 at 600 deg. Cent. In selecting a figure of merit, regard, he says, would be paid to the class of work on which the tool might be required to operate. It can readily be accepted that a hardness test carried out on a cold tool can give little or no information of what the behaviour of the tool will be when it is set to work. The cutting action generates heat and it is the properties of the tool at some elevated temperature, not its properties in the cold state, that determine its cutting abilities. To that extent Mr. Herbert's proposal represents an advance towards the solution of the problem under consideration. But that it is far from being a complete solution, and that, even in the degree of completeness which it possesses, it requires practical confirmation of its soundness, are facts which ought to be emphasised.

The merits of a cutting tool are dependent upon several prime factors, among which are its form and dimensions, its metallurgical constitution and condition, the speed at which it is caused to work, and the nature and properties of the metal it is set to cut. Mr. Herbert's criterion involves direct measurement under only one of these headings, namely, that of metallurgical constitution, and, even so, takes cognisance of but one aspect of that constitution, the hardness with which it endows the tool at some elevated temperature. The other variables are more or less admitted into the picture by the freedom allowed in the assignment of the figure of merit to be realised in any given case. In so far as the value of the figure of merit adopted is left open to arbitrary choice, Mr. Herbert's criterion lacks precision. Nor is it at all certain that in fastening on the hot-hardness of the tool Mr. Herbert is concentrating, as we believe he maintains he does, upon even the main factor determining its merit. The merit of a cutting tool lies in its ability to remove metal efficiently. It is not self-evident that the efficient removal of metal is sufficiently represented by the hot-hardness of the tool to enable us to take hot-hardness as our basis for passing judgment on the tool. There would appear to be good grounds for arguing that hot-hardness determines the durability of a tool—that is to say, the period of time elapsing between sharpenings. There is, however, no evidence that the durability is a measure of the efficiency of the tool as a remover of metal. The most durable tool is not necessarily the tool which removes the most metal in a given time. Previous investigators, for example, Messrs. Dempster Smith and Leigh, have indeed recorded many observations which show that by sacrificing durability we can increase the output of the tool. First principles and experiment alike suggest that durability in a tool is a measure, not of its efficiency as an instrument for the removal of metal, but of its brake-block efficiency. It is certain that as the rate of removal of metal is reduced the durability of the tool increases. On that ground it would appear to be illogical to take durability, or its determinant, hot-hardness, as a criterion of the efficiency or merit of a tool. Even although we assume that hot-hardness is a sound practical measure of the merits of a tool, it has to be observed that we have at present insufficient evidence to enable us to assign with assurance the temperature at which the tool should show the required degree of hardness, or the hardness which it should exhibit at a specified temperature. The only attempts to measure the temperatures generated in the tool and the work during the cutting process for which substantial accuracy has been claimed are those which Mr. Herbert himself has made and which he recorded in a paper presented before the Institution of Mechanical Engineers in the early part of 1926. There is, as we suggested at the time, strong ground for believing that the figures recorded by Mr. Herbert's ingenious work-tool thermo-couple system represent, if they represent any one thing at all, the temperature generated in the cutting tool and that they leave us almost completely in the dark regarding the effective temperature existing simultaneously in the work. At best therefore they enable us to specify the "denominator" or temperature item in Mr. Herbert's figure of merit. Since the tool, if it is to cut, must have a hardness superior to that of the metal being operated upon, the "numerator" item ought to bear some relationship to the hardness of the work metal. The work-metal hardness which counts in this connection is not the original hardness, but, as Mr. Herbert has, we think, quite satisfactorily proved, the hardness induced in the metal by the action of the tool. That induced hardness is vitally influenced by the temperature existing in the metal and cannot be specified within wide limits unless that temperature is known. Until, therefore, we know the temperature of the tool and the temperature of the work—there is some evidence that they may be as much as 200 deg. Cent. apart—we cannot hope to specify the figure of merit desirable in any given case otherwise than on a basis of pure guesswork.

Any proposed method of appraising the merits of tool metals ought to receive very close inspection and be subjected to complete practical confirmation before it is accepted as sound. Undue haste in this matter might conceivably result in serious harm being done to the engineering industry. We have by no means, it is certain, reached the limit of development in tool metals. It would be next to disastrous if we neglected or were tardy in adopting some new material because it failed to fulfil the requirements of some arbitrarily selected standard. If certain news recently received from Germany is to be trusted, there has recently been produced in that country a new cutting tool metal—we are not justified at present in referring to it as a steel—which would seem to possess remarkable properties. We have heard of its removing 550 lb. of mild steel per hour at a cutting speed of 330ft. per minute. We do not know how it shows in the matter of hot-

hardness. Much more impressive than any figure of merit could possibly be is the fact reported to us that no existing lathe was found capable of demonstrating the full properties of the metal, and that a special high-speed lathe capable of running up to 600 revolutions per minute had to be built for the purpose. It is just possible that the advent of this material may be the herald of a revolution as great as that wrought by the introduction of high-speed steel. It therefore behoves us to proceed warily in adopting any proposed system of discriminating between different tool metals which may or may not be sound for the materials of to-day and which may or may not be a fit criterion for the metals of to-morrow.

The Use of Low Grade Fuels.

It is to be regretted that men in prominent positions sometimes allow themselves to address general audiences with less reserve than they would employ were they speaking to technical men. The practice is a dangerous one, for it not only encourages hopes which often are not destined to be realised, but it leads many who have not the necessary means for examining all the points involved to condemn those who have for lack of initiative or imagination. Indeed, on the whole, more real harm is done by putting views more rosy than the facts warrant before a general audience than would be done by placing the same opinions before experts. The statements, if we may accept the newspaper reports as reasonably correct, made by Mr. Frank Hodges at Newcastle-on-Tyne on Sunday last present a fair example of what we have in mind. Mr. Hodges must have led his hearers to believe that the solution of the problem of coal conversion had been almost reached, and that it would lead directly to such an economy in the use of coal as almost to deserve the name of epoch-making. Only the most ardent believers in the new processes would venture to go as far as that, and even they, were they technical men, would hem their statements about with certain essential reservations. In our last issue we called attention to the fact, known, of course, to experts, but overlooked by the general public, that no method of coal conversion yet put forward is thermally so efficient as the combustion of raw coal under the best modern conditions. Heat units must be consumed in the process of conversion, with the result that the total products contain less thermal energy than the original products. No expert would venture to say that matters have yet advanced as far as Mr. Hodges must have led his audience to believe, and it is improbable that anyone who has carefully studied the subject is prepared to say that the production of oil from coal and the combustion of the residual fuel in a powdered form is really the economic solution of the coal problem.

The advocates of pulverised fuel were, in their early ardour, betrayed into saying that any combustible rubbish that could be pulverised might be burnt economically, and visions of wealth from dump heaps were opened before the eyes of the public. The facts are very different, and to the best of our knowledge there is no pulverised fuel plant in the world that can deal economically with coal or ashes which cannot be burnt in some other way. Where boilers are burner-fired, the quality of the coal used is generally the same as that which can be used on stokers. We may even go a step in the other direction and say that where a coal holds an inordinately high precentage of ash, it is more suitable for stoker than for burner firing. The reason is not far to seek, but, nevertheless, it is not infrequently overlooked, even amongst engineers. The equipment for pulverising coal in a power station costs at least 2 per cent. of the total cost of the station—probably in most cases it is a great deal higher. To operate and maintain the plant costs about two shillings per ton of coal pulverised. If, then, coal contains 5 per cent. of ash—a normal good coal—about a penny farthing per ton is spent directly upon the crushing of ash, part of the time of an expensive plant is used wastefully, and, with hard ash, wear and tear is increased. The efficiency attained by burning coal in a pulverised form is very little, if any, greater than that reached when it is burnt on a good stoker. Suppose now that we take the case of a bad coal, but still not the rubbish from a dump—a coal, let us say, with about 15 per cent. of ash. The cost of crushing the ash content rises to, let us say, fourpence per ton; but the trouble does not end there. The capacity of the pulverising plant must obviously be increased to deal with the extra 10 per cent. of inert material, the ash trapping and disposal equipment must be made larger, and even the boiler itself may require more heating surface. Against these additional items we have to set the fact that the poor coal is very cheap. But since it costs as much to carry bad coal as good coal, and as all the ash has got to be handled, the true cost of the coal is not nearly so low as it appears to be. It is no easy matter to make out an accurate balance of the net economy, but so far experience leans to the opinion that it is not worth while attempting to use a very poor coal in the pulverised form; it is better to burn it by the simplest means which present themselves. But the difficulties do not end with ash problems; the moisture content of the coal has also to be considered, and only those who have seen the size of the plant which is required for that purpose even with a moderately dry coal will at once appreciate what the drying of a very wet fuel—such, for example, as the sludge from a coal hydrogenation plant—involves. Some forms of unit pulverisers can, it is claimed, work efficiently with 15 per cent. of moisture, but even they would fight shy of the residuals from such plants. Both centrifuging and hot drying would be necessary. The only other argument which need be considered is that there are fuels so bad that they can only be burnt after pulverisation. Let us agree that it is possible to burn dumps by pulverising them, no one has yet succeeded in showing that it is economical to do so; and no one is in the least likely to do so until the price of good coal is much higher than it now is.

All these facts are quite familiar to anyone who has studied the problems of economical steam generation, but they are not well known by the general public. When it is told—as it has sometimes been told—that a method has been invented by which all the ash heaps in the country may be burnt in a furnace, it immediately jumps to the conclusion that a great advance has been made; when it hears that chemists have discovered a way of turning coal into oil, it at once believes that the oil fuel problem has been solved. It does not, it cannot from lack of the necessary knowledge, examine all the details of the problem. It cannot work out either an economical or thermal balance sheet. It is misled, quite unintentionally, by its informants, and when it finds its hopes unrealised, it distrusts in future even the experts and makes scathing remarks about the prophecies of scientists. It is, therefore, of the greatest importance that newspapers and public speakers who address a general audience should speak always with reserve, or should satisfy themselves by impartial inquiries that the statements which they circulate are absolutely true. The public speaker is in an exceptionally difficult position. The daily Press can rarely spare space for more than a summary of a speech. With the best intention in the world, the reporters are likely to seize upon statements and to omit the clauses by which those statements are safeguarded. It behoves speakers, therefore, to use especial care when addressing non-technical audiences upon technical matters to avoid the use of statements which may be divorced from their context and raise ill-founded hopes.

Literature.

Alluvial Prospecting. By C. Raeburn and Henry B. Milner. With a Foreword by J. D. Falconer. London: Thomas Murby and Co. 1927. Price 36s. net.

Alluvial deposits were naturally the first mineral deposits to be worked by primitive man, and they have continued to attract miners up to the present day. They are for the most part easily discovered and readily accessible, lying generally at the surface. Their exploitation calls for comparatively little skill, and requires as a rule only simple and inexpensive plant, whilst the risk attending the operation is far less than that presented by primary deposits. For all these reasons alluvial deposits have been worked out far more rapidly than have the world's primary deposits; but their contribution to the mineral output of the world is still very important, although this importance is necessarily declining year by year. There are, however, still numerous bodies of men engaged in working alluvial deposits, and under modern conditions it is absolutely necessary that accurate knowledge as to the volume and richness of such deposits should be forthcoming before any attempt is made to work them seriously. The acquisition of such knowledge is the work of the alluvial prospector, and the object of the present work is to teach him the rationale of alluvial prospecting and to indicate the scientific principles upon which it is based.

Prospecting may embrace many different phases and a very wide range of operations. It may be carried on by the hardy individual, who, with his pack on his back, or, if he is relatively prosperous, loaded on a donkey, starts off alone into unknown country to search for mineral wealth. He is as a rule quite indifferent whether such wealth exists in the form of a clastic deposit or of a primary deposit, although the former is naturally better adapted to his purpose for the reasons already given. At the other extreme of the scale comes the prospecting expedition fully equipped and sent out, usually, by a syndicate with ample funds at its disposal. Such an expedition will generally comprise trained geologists, surveyors, mining engineers, and possibly also assayers with a laboratory equipment. It is obvious tnat a book written for a man of the first-named class would have nothing in common with one adapted to the needs of one of the latter. Indeed, the old-time prospector never burdened himself with books at all; experience, which in a man of the right type frequently develops into what appears to the looker-on to be a kind of uncanny intuition, was as a rule his sole guide. Hence, if a book is to be of any use at all to the prospector, it is to men of the latter class that it must be addressed, and the book before us is no exception to the rule, though it must be admitted that it every now and again descends to elementary matters, with which such men as would be selected for a prospecting expedition must already be quite familiar, and it is difficult to avoid the impression that the authors had not always definitely made up their minds what class of prospector they intended their book to reach.

The volume contains an excellent summary of the nature of alluvial deposits, together with a full account of the various minerals likely to be met with in such deposits, and the means of recognising them, and will, therefore, form a valuable companion to any technically trained man engaged in such prospecting work. It may, however, be suggested that the authors are trying to widen unduly the scope of the prospector's operations, as indicated in the following sentence: "The duty of the prospector is twofold—he is not only the seeker for economic mineral deposits, but also their valuer." Surely the work of a prospector is not that of the valuer, both representing distinct fields of operation. Mineral valuation is, strictly speaking, an actuarial process based upon strictly mathematical methods, whereas the collection of the necessary data for making the valuation is the duty of the prospector. The latter may not have, and as a rule has not, the mathematical equipment necessary for a satisfactory valuation, but he is or should be thoroughly well qualified to collect the data on which the valuer goes to work. No better evidence as to this division of labour can be asked than is afforded by the work before us. The authors are evidently thoroughly qualified to advise the prospector, but whenever they have ventured into valuation, as they have in places, their methods are faulty. The errors involved may not be very serious, but in a work of this kind principles ought to be stated with absolute accuracy.

The scientifically trained prospector whose work lies in alluvial regions will find in this book a very complete and very satisfactory compendium of all the information that he is likely to require in the course of his ordinary daily operations.

Punjab Irrigation Nomograms. By E. S. Lindley, M. Inst. C.E. The Thomason College Press, Roorkee, 1927. London: E. and F. N. Spon. Price 20s.

The author explains in his introduction that his book presents for use a number of nomograms by means of which engineers of the Punjab Irrigation Department and others similarly employed perform calculations occurring in their work. Engineers who have used both the Cartesian and the nomogram methods of graphical calculation will agree with his claim that the latter are superior to the former in several respects, especially as regards the angles formed by intersecting lines; although, as he is careful to point out, not all formulæ can be reduced to convenient nomograms, while for exhibiting the inter-relations of factors, as distinct from calculation, a Cartesian diagram is easier to understand.

Of the fifty-eight nomograms in the book, seven only are taken from outside sources. Mr. Lindley has, therefore, performed a useful service in making available for the use of hydraulic engineers generally so considerable a collection of diagrams by means of which calculations may be performed without brain-work on the part of the engineer, or, when due instruction has been given, by persons having small technical or mathematical skill. Thus, although engineers will usually find the diagram self-explanatory, and will appreciate the suppression of all but essential printed matter on the plate, the boldly numbered textual explanations which, with examples, occupy the rest of the book will enable many assistants and draughtsmen to understand the methods and to apply them efficiently. To this end the explanations of five of the plates have been written as a course of instruction for beginners.

In the event of a second edition of the book being required, the author might do well to revise or extend his "explanations." The words used and the references to Punjab practice, though perfectly understood

in that province, are not all readily intelligible even to irrigation engineers in other parts of India, still less to those who have not had Indian experience and are not irrigation engineers. In view of the wide field in which the nomograms may usefully aid in computations, it is undesirable that those using them should be hampered, in some cases, by a lack of familiarity with allusive terminology. Some of the explanations need no examples, but most of them have one or more apiece, the total number of examples being more than eighty. As regards the calculations for channels, weirs, sluices, flume outlets, syphons, gauge outlets, flood discharges and the like, it is sufficient to note their adequacy as a set. The work is not, however, limited to this field. Under the heading of materials we find diagrams for strength calculations and other computations in the case of rolled steel and timber beams, reinforced concrete beams and slabs, retaining walls, columns, foundations, and concrete proportioning. With the explanation of the nomogram for calculations based on Kütter's and Bazin's formulæ, four examples are given, and a good table of values of n. For trapezoidal channels eight examples are given, for Garrett waste weirs six, for undersluices three, and similarly in other cases.

The reviewer made a simple test of rapid calculation of a coefficient derived from Kütter's formula, and given in tables as 76·6. The nomogram gave 76·5. Directly from the table the corresponding velocity was 2·97, by calculation 2·98. Another diagram gave 1·99 for 2·00, and in a bad light 2·96 for 3·00. These nomograms are, in fact, more than sufficiently accurate in many cases for the computation of values depending upon the degree of accuracy with which dimensions of channels are obtained by digging, depths of water measured by ordinary means, or values of n estimated. The pages are large enough to enable a space nearly 8in. by 11in. to be devoted to a single nomogram when necessary, or for such division of the space as may be sufficient for two or more. There is, therefore, no undue cramping.

Though the author expressly states that it is not his purpose to teach how to make nomograms, the book does, in fact, provide examples of spacing and arrangement, such as may help engineers in making their own nomograms for special calculations, thus somewhat enhancing the value of this time and brain-saving volume.

Overhead Electric Power Transmission Engineering. By WILLIAM T. TAYLOR. London: Charles Griffin and Co., Ltd. Price 35s.

Now that transmission lines are beginning to be employed in this country, it is only natural that books dealing with overhead lines should be produced. While some authors deal exclusively with the mechanical side of the subject, others devote their attention to the electrical side. In the present case the author covers a very wide field, and considers both mechanical and electrical problems. The book constitutes a treatise on design, construction, operation, protection and maintenance of overhead electric transmission lines, and apparently the information it contains is based on long experience. There are over 100 tables showing mechanical and electrical properties of lines, supports, &c., of pressures and loads due to weather conditions, together with sag and tension tables calculated in accordance with the new standards. There are also many diagrams and other illustrations, some of which show lines erected in various parts of the world. A special feature of the book is that at the head of each chapter there is a carefully prepared argument which enables the reader to understand the theme or topic discussed in the chapter that follows.

Like most engineers who have had anything to do with the erection of transmission lines in this country, the author is opposed to the present laws that impede progress. Useful and interesting information is given concerning the conditions under which wayleaves have been obtained in various parts of this country, as well as particulars of the conditions under which transmission lines can be erected in certain parts abroad. In Italy, for instance, the supply companies have the right of eminent domain. Transmission lines can be erected over the straightest and shortest course, arrangements being made for fixing the price of the land utilised and of all litigations that may arise. This law is said to work very satisfactorily, and has greatly facilitated the transmission of electrical energy by means of overhead wires.

The book contains fourteen chapters and an appendix on regulations for overhead lines. Following the first chapter on development in overhead line transmission, in which much is said about the advantages of lines for interconnection, there is a chapter on factors controlling the design and construction of transmission lines. Here the author expresses the opinion that a copper conductor usually has the best all-round advantage over all other metals used as line conductors, although for use in long spans steel-cored copper conductors are giving excellent service. Aspects of transmission line survey and location is the title of the next chapter, which is followed by one on transmission line conductors, wherein the author gives what he considers to be the merits and demerits of different kinds of conductors. Following this there is a chapter on stress, temperature sag and span. The next chapter deals with the practical aspect of the electric power transmission circuit, where the reader is shown, among other things, how the size of conductors for transmission lines is arrived at. Following a chapter on transmission telephone lines, there is one on wood pole lines. Other chapters deal with steel line supports, line insulators, transmission line erection, protection of overhead transmission lines, operation and maintenance, and studies of transmission line costs.

It will be seen that the book covers a very wide field, and in view of the present proposals to interconnect power stations and to supply electricity to wide areas at present without supplies, the volume should meet with a very fair demand.

Electric Winders. By H. H. BROUGHTON. London: Ernest Benn, Ltd. 1927. Price 52s. 6d.

THE subject of electric winding is attracting increasing attention and becoming of increasing importance in this country, and it was high time that an authoritative book on the subject made its appearance. Very much has been written on the subject of electric winders in the technical Press and in the publications of technical societies, but this information was widely scattered and necessitated the expenditure of considerable time when it was desired to collect data. Mr. Broughton has, therefore, done the mining industry a very distinct service in the preparation of his book on the subject. He deals in detail with all the points that are likely to arise in discussing a problem of electric winding. It may perhaps be suggested that he takes the electric winder somewhat too much for granted; he does not attempt to show that it is necessarily more efficient or more economical than the steam winder, and his work contains no hint that there may be conditions under which the latter is preferable. He discusses in detail the mechanics of the mine hoist, with cylindrical, cylindro-conical and conical drums and reels, and points out the importance of the drum profile. The electrical equipment and different types of electrical systems are investigated, and chapters are devoted to such details as winding ropes, shafts, bearings, &c., gearing, brakes and operating gear. Full attention is given to the variation of mine conditions, such as those caused by inclined shafts, compound shafts, and by winding from different levels, and in a final chapter examples of a number of important typical electric winders are given. The author mentions briefly the Koepe system of pulley winding, but hardly devotes sufficient attention to this method, which he describes as "at one time used to a large extent on the Continent." Seeing that some of the most recent winding plants in the North of France have been constructed on the Koepe principle, this statement can hardly be considered correct, and the author should, at any rate, have indicated that the system is used in this country. He dismisses without any consideration the important method of mounting the Koepe winder in the headgear itself, and thus doing away with headgear pulleys. There are two examples of this arrangement in this country. It is true that the most recent description of such a plant from the pen of its designer, Mr. George Raw, B.Sc., was only published in July last, and therefore probably too late to enable Mr. Broughton to refer to it, but the plant has been running for some time, and it may fairly be claimed that he ought to have been aware of its existence.

It is also difficult to understand why the author makes the statement concerning the equalised Ward Leonard system that "on the Continent it is called the Ilgner system." This sentence would surely lead anyone to suppose that the term Ilgner system was too little known or too little understood in this country, whereas quite the reverse is the case, this being, in fact, the more usual term, whilst the term used by the author is but rarely heard in connection with winding, though familiar enough in other connections.

The book is admirably got up and illustrated, and contains a mass of extremely valuable information, for which the mining engineer, whose attention may in the future have to be directed more and more to electric winding, will undoubtedly be very thankful.

Studies in Naval Architecture; Strength, Rolling. By A. M. ROBB, D.Sc. London: Chas. Griffin and Co., Ltd. Price 25s. net.

THE title of this volume is very apt and well expresses the nature of the contents. As the author states in the preface, the matter largely consists of lectures delivered to university students, and in it has been brought together the most important investigations—theoretical and experimental—that have been made in the fields of strength and rolling of ships.

The selection of these two distinct branches of naval architecture to be placed together to constitute one volume may at first seem odd, but they have a common link in waves and wave formation, and the author devotes the two first chapters to a preliminary consideration of the trochoidal wave and the ellipse of inertia respectively. As these two chapters are essentially an introduction and foundation for the subsequent matter, it would have been better had they been placed separately as such, instead of being incorporated in "Strength."

The question of strength is dealt with very fully from the consideration of the external forces acting upon a ship to the determination of the stresses induced thereby in the structure, and the resulting deflections of the latter. The effects of heaving and pitching are dealt with, and longitudinal, transverse and local strength, and structural attachments are treated in turn.

The section on rolling is equally comprehensive. In addition to the consideration of still water rolling and rolling amongst waves, the methods of measuring angles of roll and means of reducing rolling are given. However, one must criticise Section 1 of Chapter XII. Here is a mathematical problem, but although the correct result is obtained there is some mistake in the development, for a body moving in a circle has an acceleration towards the centre, not outwards, as stated by the author. The error is probably due to confusion with that old bogey "centrifugal force," for which the author betrays a liking elsewhere in his book.

On the whole, the book is very sound. There is little new matter, however, and the value lies in the excellent way in which the author has compiled the existing knowledge of his subjects.

Two good features should be pointed out. The reader has a complete guide to practically all relevant books and papers in the footnotes and in the references at the ends of the chapters, while the author has illustrated his text with examples fully worked out, these also being placed together at the ends of the chapters.

The book is one that should be more useful to students—to whom the author really addresses himself—than to those professionally engaged in naval architecture, and to students it can be well recommended, while professional men may find it handy for reference.

BOOKS RECEIVED.

Die Viskosekunstseidefabrik ihre Maschinen und Apparate. By Ed. Wurtz. Leipzig: Otto Spamer. Price 8 marks net.

Lynx IV. Aero-engine. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. 6d. net.

Jupiter Series VI. Aero-engine. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. 6d. net.

University of London Centenary Addresses. London: The University of London Press, 10, Warwick-lane, E.C. 4. Price 12s. 6d. net.

Modern Practical Carpentry. Third edition. By George Ellis. London: B. T. Batsford, Ltd., 94, High Holborn, W.C. 1. Price 30s. net.

The Measurement of Air Flow. By E. Ower, B.Sc., &c. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 15s. net.

River Engineering. By F. Johnstone Taylor. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 4s. 6d. net.

The South American Handbook, 1928. London: South American Publications, Ltd., Atlantic House, Moorgate, E.C. 2. Price 2s. 6d. net.

Steel Works Buildings. By A. G. Swift. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. 6d. net.

Applied Heat. By Dipl.-Ing. J. Oelschläger; edited by H. Moss, D.Sc. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. 4. Price 30s. net.

Armaments and the Non-combatant. By E. F. Spanner. London: Williams and Norgate, Ltd., 14, Henrietta-street, W.C. 2. Price 12s. 6d. net.

Cranes. By F. J. Wiggle. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

The Phase Rule and its Applications. Sixth edition. By A. Findlay. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 10s. 6d. net.

Gemeinfassliche Darstellung der Gesamten Schweisstechnik. By P. Bardtke. Berlin: V.D.I. Publishing Department, Berlin, N.W. 7. Price 12·50 marks net.

The Lake Plateau Basin of the Nile. Second Part. By H. E. Hurst. Cairo: Government Publications Office, Ministry of Finance, Dawawin, Egypt. Price Piastras 10.

Transactions of the Institution of Naval Architects, 1927. Vol. LXIX. Edited by R. W. Dana. London: The Institution of Naval Architects, 5, Adelphi-terrace, W.C. 2.

Ministry of Public Works, Egypt. The Irrigation Service, its Organisation and Administration. By P. M. Tottenham. Cairo: The Government Press. 1927. Price P.T. 20.

Annales des Ponts et Chaussées—(*a*) *Partie Technique*, (*b*) *Partie Administrative.* 1927. Fasc. 5, Septembre-Octobre. Paris: A. Dumas, 6, Rue de la Chaussée-d'Antin. 1927.

Cantor Lectures on Photo-Elastic Measurements of Stress Distribution. By Professor E. G. Coker. London: The Royal Society of Arts, John-street, Adelphi, W.C. 2. Price 2s. net.

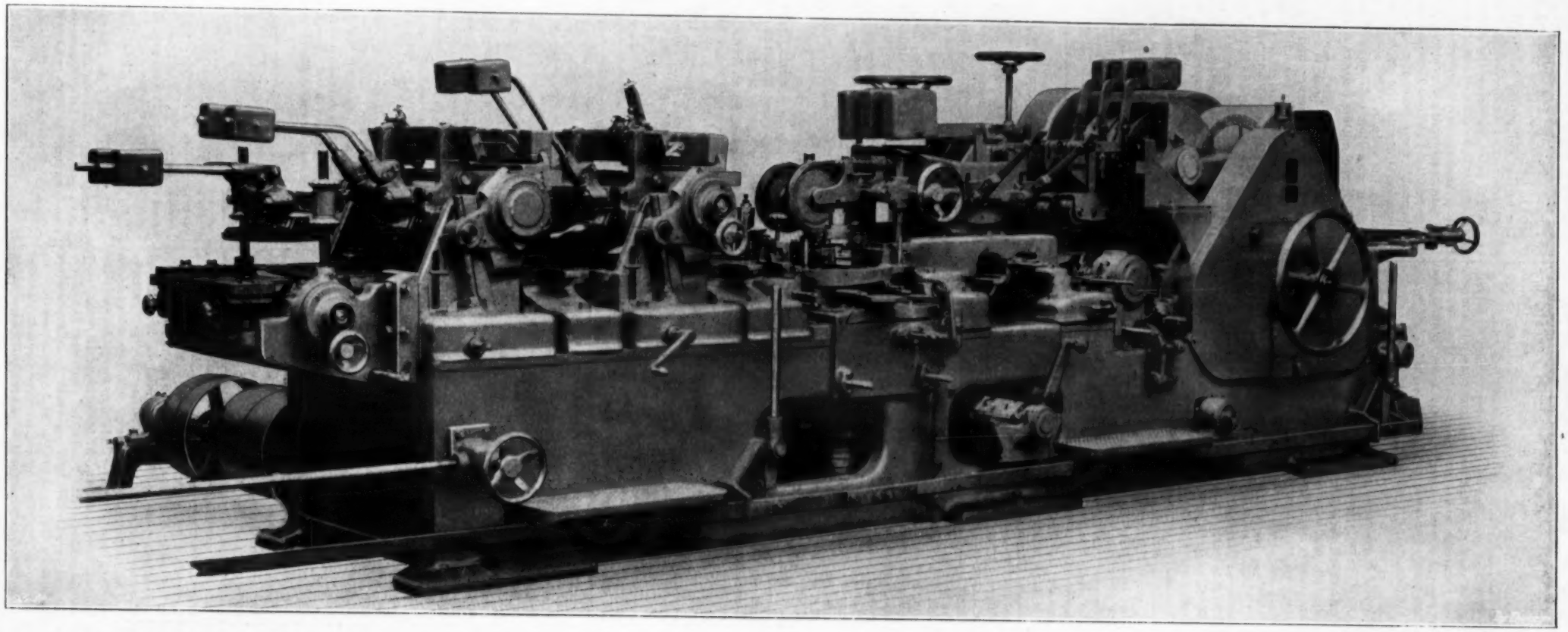
The American Society for Testing Materials: Tentative Standards, 1927. Philadelphia: The American Society for Testing Materials, 1315, Spruce-street. Price, 7 dollars paper bound and 8 dollars cloth bound.

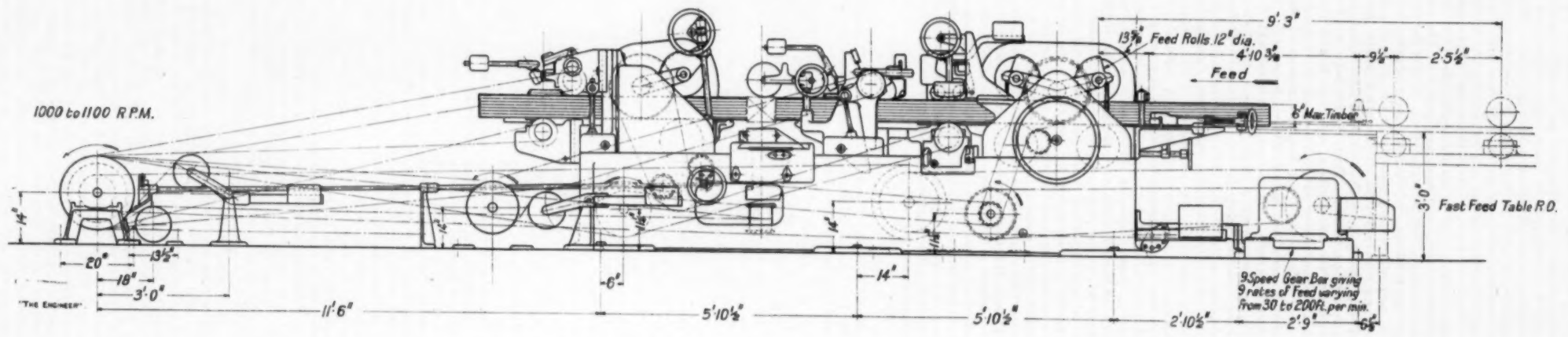
Atlas Metellographicus. Series I., Tables and Plates 1 to 8; Series II., Tables and Plates 9 to 16. By Professor Dr. Heinrich Hanemann and Angelica Schrader. Berlin: Gebrüder Borntrager, Berlin, W. 35. Schöneberger Ufer 12A. Price: Series I., 7·50 marks; and Series II., 6·75 marks net.

HIGH-SPEED PLANING, MATCHING, AND MOULDING MACHINE

THOMAS ROBINSON AND SONS, LTD., ROCHDALE, ENGINEERS

(*For description see opposite page*)





Two Improved Wood-working Machines.

SURFACING, THICKNESSING AND SIZING MACHINE.

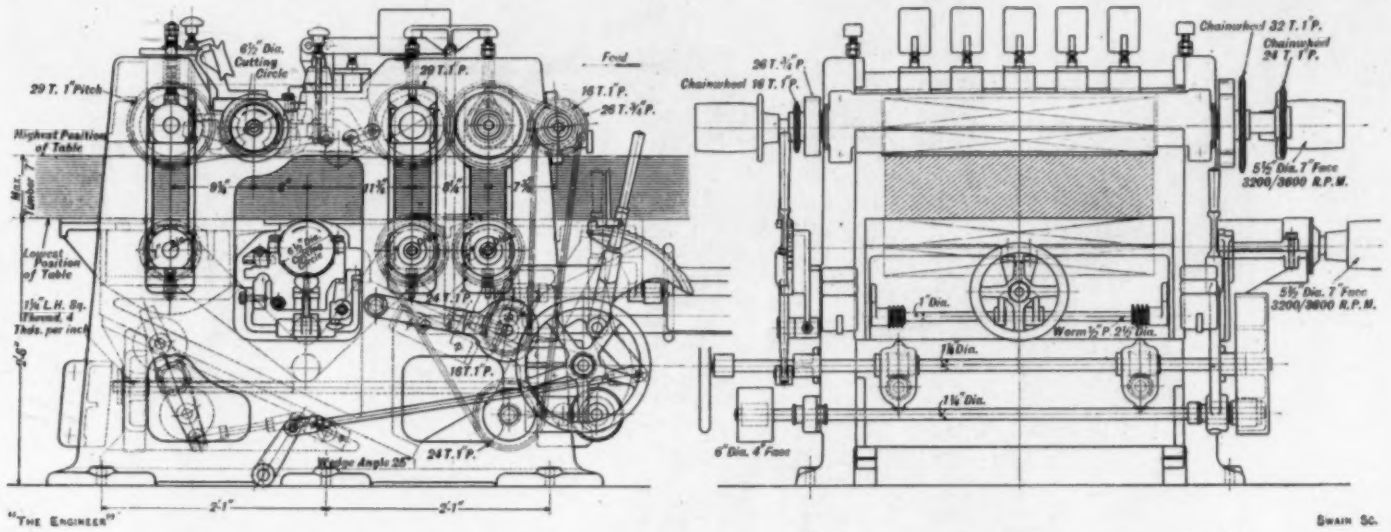
A NEW machine for surfacing, thicknessing and sizing timber, embracing several important improvements, is illustrated in the accompanying engravings. In the drawing the machine is shown arranged as a double surfacer to plane the top and bottom of the timber only, while in the half-tone engraving on page 664 it is shown with vertical side spindles to enable all four sides of the board or panel to be planed at the same time. The machine has been specially designed by Thomas Robinson and Sons, Ltd., Rochdale, to give a large output with a high-class finish on both hard and soft timbers, and is particularly intended for carriage and wagon works, shipbuilding yards, &c.

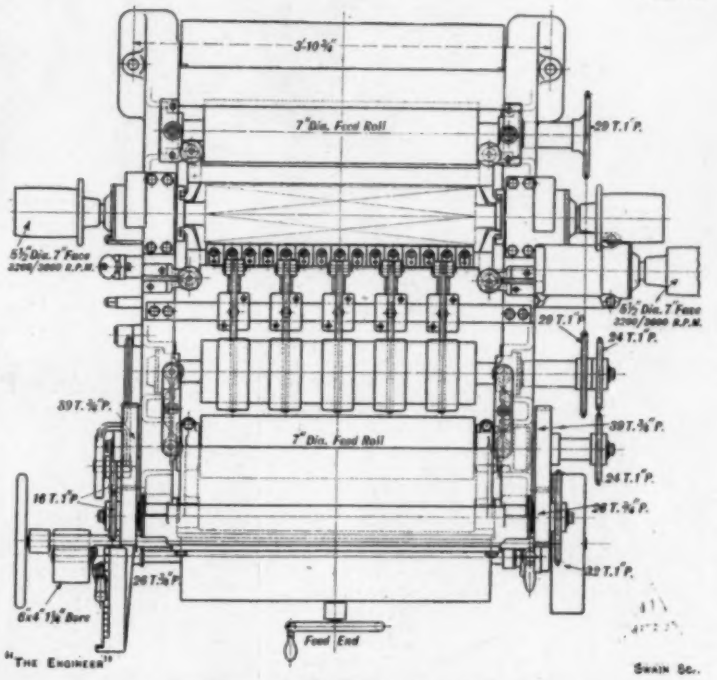
The upper part of the main frame carries the top cutter-spindle and feed rollers, while the lower portion supports wedges on which are mounted the main and feed tables and the bottom cutter spindles. The frame is well ribbed and has massive cross ties of box section dowelled in position, and it will be observed that no parts project below the floor level, which does away with the necessity for extensive foundations or cellar space.

The tables are arranged so that they can be raised or lowered either by hand or by power by means of a screw motion which traverses the wedges or inclined slides supporting them. The power motion is controlled by friction pulleys, an automatic knock-off device being provided to prevent over-running. The height of the table is shown on a graduated rule at the front of the machine. There is a feed or subsidiary table in front of the bottom cutterhead, which is provided with independent adjustment to allow the depth of cut to be varied, and is adjusted by a hand wheel at the front of the machine which operates a link motion. The bottom in-feed rollers in this table are independently adjusted to suit rough sawn or wet timber, and a graduated rule is also fitted to show the depth of cut.

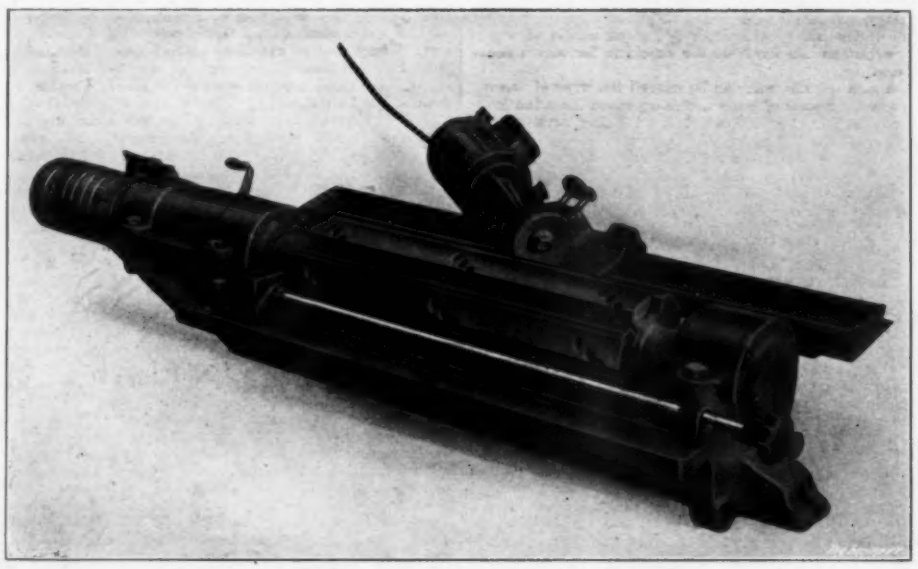
In the four-cutter machine depicted in the half-tone engraving on page 664 the main table is extended at the tail end to give support to the timber between and after leaving the vertical side spindles. It is fitted with a locking device to provide a rigid support while working, which is controlled from the feed end of the machine, and is so interlocked with the rising and falling motion that the latter cannot be operated until the lock is released. The cutter-spindles are all mounted in double-row ball bearings, and the cutter blocks are of the circular type carrying ordinarily four thin high-speed steel knives, though they can be arranged with six knives if preferred. Truing or jointing devices, consisting of an emery stick carried in an adjustable holder mounted on a slide set parallel to the axes of the cutter blocks, are provided for all the heads. For truing up, the stick is traversed across the path of the cutters, while the latter revolve, and slightly "tops" them, so as to ensure that each cutter shall perform its fair share of work. This truing of the cutters produces an excellent finish, particularly on hard woods, and increases the output very considerably.

The top spindle, which has the heaviest work to perform, is carried in four bearings, one of which is arranged to take the thrust, and the spindle is furnished with a pulley at each end for a double drive. The bottom cutter-spindle is mounted in three bearings, two at the driving end and one at the other end. This spindle is carried in a cradle, built into the main table, and arranged so that the complete cutterhead may be drawn out for inspection and changing or for grinding the cutters—as shown in the half-tone engraving below. The cradle is carried on and pivots about a round headed lide at one side, and rests on a flat slide at the opposite side. The flat slide is supported by an excentric to give a rising and falling adjustment to the head, a locking device being fitted to retain the correct position. Independent adjustment is provided at each end of both slides to permit the cradle to be levelled, and a quick acting screw cramp is provided for holding the cradle in position.





SURFACING, THICKNESSING AND SIZING MACHINE



BOTTOM CUTTER HEAD CRADLE AND TRUING DEVICE

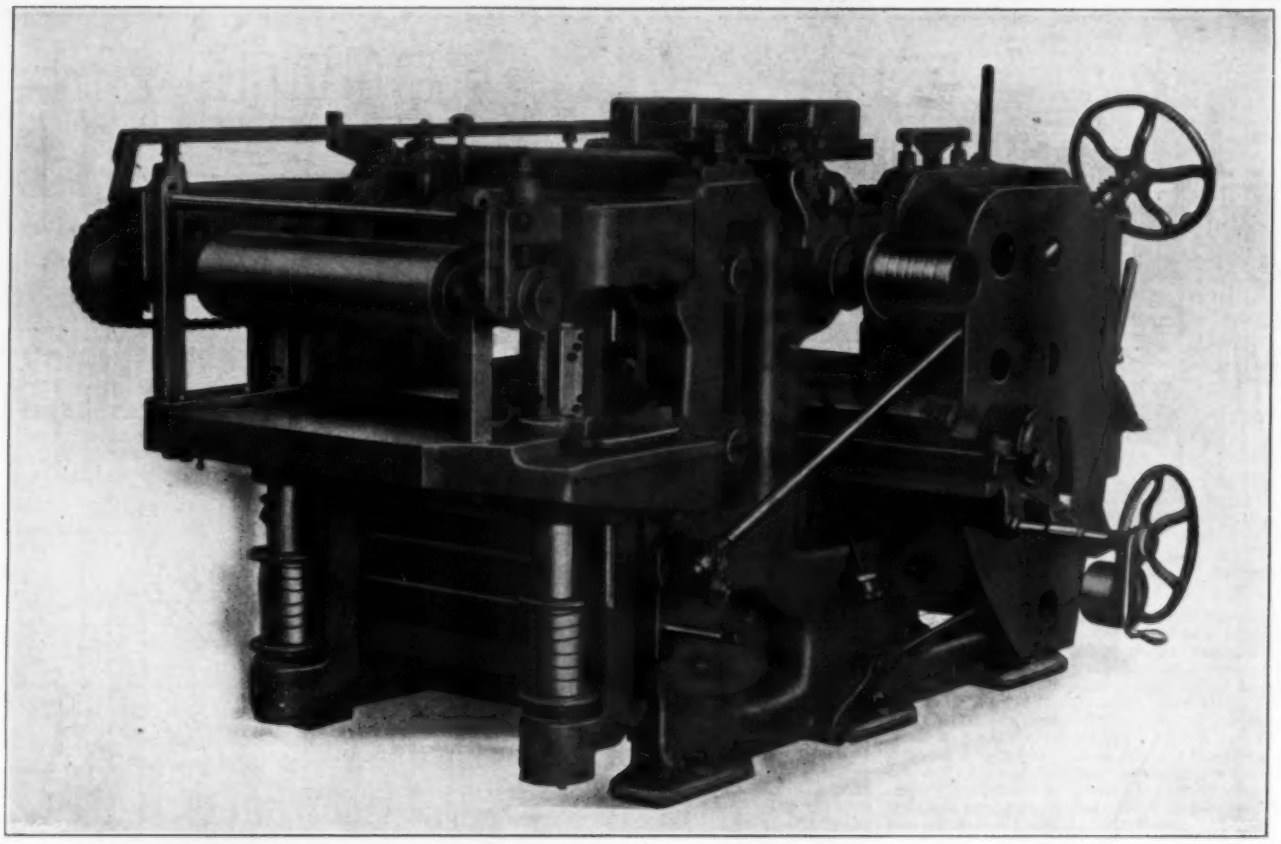
The vertical side spindles are carried on slides fixed to the main frame, and are also mounted on double row bearings, both spindles being adjustable transversely. The fence side head has only slight adjustment, while the near side head can be adjusted completely across the machine. This adjustment is effected by the large hand-wheel and inclined shaft at the feed end, which operates a skew gear and screw. An indicator at the feed end shows the position of the near side head and a safety guard is moved across the table at the same time to prevent timber being put into the machine which is too wide to pass the side heads.

The feed motion consists of six rollers 7in. diameter, three being arranged above the timber and three below, all rollers being power driven by heavy roller chain and gearing from a vee belt speed gear of the expanding pulley type. All the feed rollers are mounted on enclosed double row ball bearings, and are arranged with two top and two bottom rolls in front of the horizontal cutter blocks, to give high feeding power, and one top and one bottom roller behind the blocks. The two top in-feed rolls are of the sectional type to allow for irregularities in the thickness of the timber and to feed varying thicknesses at the same time. The first roll is driven at each end by spur gears and carried in a swing to provide a parallel lift. Pressure is applied to these two rolls by levers with adjustable weights acting on a whiffle tree or yoke to give an even yet flexible pressure. The remaining top roll is spring-loaded and has adjustment to vary the tension. The feed is controlled by a signal lever at the left-hand side of the feed end, which operates a double belt-tightening device, and is provided with a notched quadrant to retain the lever in position. The vee belt variable-speed gear referred to provides a speed range ordinarily between 20ft. and 100ft. per minute, but it can be arranged to give a feed up to 150ft. per minute if desired. The shafts are all mounted on ball bearings and splined for the expanding pulleys. The four-cutter machine is provided with an additional upper feed roller at the out-feed end. It is carried by brackets from the machine frame and is also chain driven, runs on ball bearings, and is provided with a spring pressure.

The cutter block pressure regulators are of the sectional type, those over the bottom head being weighted slippers, of the spring-loaded radial type with steel shoes in front of the top cutter block. The pressure bar behind the top head is mounted in circular guides concentric with the block, and all the pressure regulators are so arranged that they cannot foul the cutters. The near side head has a radial type chip-breaker pressure device, which is fitted with a renewable steel shoe, and is carried from a small table which is adjustable with regard to the cutter head.

SURFACING, THICKNESSING, AND SIZING MACHINE

THOMAS ROBINSON AND SONS, LTD., ROCHDALE, ENGINEERS



A portable electric grinder can be fitted to the machine for grinding the knives without having to remove them from the blocks. The counter shaft and loose pulley are mounted on ball bearings, and tension pulleys, also running on ball bearings, are provided for the side head drives.

High-speed Planing, Matching and Moulding Machine.

The illustrations on page 662 represent a four-roller high-speed planing, matching and moulding machine with numerous new features which Messrs. Robinson have also recently built. It is especially suitable for large planing mills, carriage works and shipbuilding yards. The cutter heads and feed gear are all carried on a massive frame which is well ribbed and provided with heavy cross ties, and as no portion of the mechanism projects below the floor line deep excavations are unnecessary. The feed gear consists of four heavy rollers, 18in. diameter, with the shafts mounted in enclosed roller bearings and provided with an indicator to show the depth of timber passing through the machine. As is now the makers' usual practice, the rolls are driven by steel roller chains running in an oil bath gear case provided with adjustable sprockets to keep the chains in tension. As will be seen from the drawing on page 662, the primary chain runs from a gear-box to a pinion shaft from which a secondary chain drives the centre or swing shaft of the rolls. The bottom rolls are driven from this centre shaft by another chain and the top roll by spur gears to provide for the rise and fall motion. This method of driving, it is claimed, gives more silent running than spur gears and reduces the number of wheels required. A very wide range of feeds is provided by the gear-box—actually from 35ft. to 250ft. per minute—obtainable by the operation of two levers, while the starting and stopping of the feeding rollers is effected by fast and loose pulleys and can be controlled from three points, namely, at the feed end of the machine, at the vertical side spindles, and at the tail end of the machine.

The weighting system for the top feed rolls is of the firm's special design and is intended to prevent excessive movement of the weights while retaining the maximum leverage. The weight lever is suspended from a cradle attached to the weight rods by chain gearing, and a screw and a second chain anchor the fulcrum of the weight lever, which rises and falls simultaneously with the cradle, thus maintaining the weight lever approximately horizontal.

The bottom feed rolls are carried in roller bearings supported by wedges with independent screw adjustment for levelling and regulating the height of the rolls relatively to the table. The wedges are carried on a cradle with screw adjustment to allow the rolls to be raised and lowered bodily, the cradle being linked to the table in front of the bottom cutter head which is also mounted on inclined slides and rises and falls simultaneously with the feed rolls. The cutter spindles all run in ball bearings in dust-proof housings.

The bottom cutter head carries a cutter block of the circular pattern with eight thin steel knives which are secured by wedges and can be readily set up. The bottom cutter spindle is carried in a hopper frame mounted on a round-headed slide at one side and a flat slide at the other side, and the latter is raised and lowered by an excentr c to give a tilting movement about the round-headed slide, thus providing a sensitive rising and falling adjustment. Provision is made for levelling the slides and for drawing the cutter head out of the machine for access to the knives. To lock the head in position a screw clamp is provided. This spindle is driven by belts from fast and loose pulleys.

The "pressures" over the bottom cutter head are self-adjusting as far as possible, to hold twisted timber firmly down to the table. The fixed knife planing section follows the first bottom cutter head and has two independent knife boxes, either of which may be withdrawn for sharpening the knife without stopping the feed. A double roller pressure is provided over this section and is so arranged that the pressure over each knife can be relieved independently by means of a hand lever. Fixed vertical side knives are provided behind the side cutter heads for planing the edges of the timber, and the knife holders are arranged to rise and fall to enable a wide knife to be fully used on thin timbers. These side knives also serve as guides behind the rotary cutter.

A rotary shavings breaker or chopper is provided immediately below the horizontal fixed knives and can be withdrawn from the machine for access to the knives for adjustments, &c.

The vertical side spindles have plain ends 1¾in. in diameter, suitable for self-centring cutter blocks. They are mounted in ball bearings each complete spindle with its bearings being supported in a circular housing which is arranged to rise and fall. The circular housings are carried on wide saddles mounted on horizontal slides, the upper boss of the saddles being split and fitted with a locking device for holding the housing rigidly while working. The rise-and-fall adjustment is accomplished by means of vertical screws and spiral gearing, the operating shafts of which are brought to the front of the machine for convenience of operation.

Each side spindle unit can be moved transversely across the frame by means of screws, also operated from the front of the machine, the left-hand head being arranged to travel across the full width of the timber. This mounting ensures rigidity and freedom from vibration, in addition to easy access to the cutter heads. The left-hand side head has a radial type chip breaker with a renewable steel shoe and allows for large variations in the width of the timber, pressure being applied by a chain and spring. Spring-loaded rollers are provided between the cutter heads.

The machine is fitted with two horizontal cutter heads for operating on the top surface of the timber. The first head is provided with a removable spindle to accommodate various types of cutter heads, such as a square-lipped block to take plain and mould cutters, and profile heads carrying milled bits. Horizontal adjustment is arranged. The second top head is fitted with circular type cutter blocks to carry eight thin steel knives. Each cutter head is carried in an open type frame connected both below the bed and behind the cutter block with substantial cross ties, making the whole unit very rigid, and the cutter block at the same time very accessible. The cutter head frame is raised and lowered by two screws operated through bevel gearing by means of a crank from the front of the machine, the weight being taken by ball thrust bearings and a scale being provided to indicate the setting for the thickness of timber required. The pressures in front of the cutter heads are of the weighted chip-breaker type with sectional steel shoes, and can easily be lifted for access to the block. The pressures behind the heads are of the weighted slipper type arranged to carry wood pads which can be shaped to suit the outline of the work and can be adjusted across the timber.

An extra bottom or beading head with a removable bearing and cutter block to enable the latter to be changed for profile heads carrying milled bits is fitted at the tailing-out end of the machine. The complete head is adjustable vertically and is provided with a rear table arranged to swing away for access to the cutters. This table also has an independent vertical adjustment. The table is provided with detachable steel plates which can be adjusted to and from the cutters to suit the width of gap required and can be renewed when worn.

All the heads are provided with truing devices similar to those described above.

An automatic feeding-in table is supplied for use with the machine and is essential if large outputs are to be obtained with economy of labour.

Institution of Mechanical Engineers.

North-Western Branch.

In these times when the art of after-dinner speaking is frequently lamented as lost, it is a pleasure to be able to report an occasion of this kind when the remarks of the various speakers were listened to with such interest as was the case at the annual dinner of the North-Western Branch of the Institution of Mechanical Engineers, held at the Engineers' Club, Manchester, on Thursday, 1st inst. There was an excellent attendance of members, and Mr. H. F. Massey, chairman of the Branch, presided. Amongst the guests were Sir Henry Fowler, President of the Institution, Mr. W. L. Hichens, the Presidents of other kindred institutions, and the members of the "Steam Nozzles Research Committee." In proposing the toast of "The Institution," Mr. W. L. Hichens set a high standard for succeeding speakers to emulate. After a brief eulogy of the past work of British engineers, and especially of locomotive engineers, in which connection he mentioned the Royal Scot, the design of Sir Henry Fowler, Mr. Hichens made a plea for what he called the "rationalisation" of industry. By "rationalisation" Mr. Hichens said he would not go as far as they wished to go in Germany, which meant monopoly, but advocated rather a combination of certain firms when such a combination meant greater efficiency and important economies. We had not done much in that respect, largely, he thought, because we in this country were such convinced individualists. He gave, as an instance of combination, the railways of this country, the number of which had been reduced from 125 before the war to four at present. He knew that there were critics of that movement, but he thought that when the new organisations had had time to settle down it would be found that they were very much more efficient and economical than the constituent bodies of which they were composed. In the steel industry, the shipbuilding industry, in the coal industry, and in the electrical industry, those problems ought to be considered more seriously than they had been. At the present time the most hopeful sign of all was in the relationship between capital and labour, which to-day was far better than for a long time. Only a few years ago labour was in a wrecking mood or anxious to block capital out as a first step towards the inheritance of the industrial world by the Socialists, but it was now recognised that, like the Siamese

twins, neither capital nor labour could exist without the other. In replying to this toast, Sir Henry Fowler recalled some of his early associations with Manchester. He referred to the good work which was being done by the local branches of the institution, and congratulated Manchester engineers on their club. The toast "Our Guests" was given in a humorous after-dinner manner by Mr. H. L. Guy, member of the local committee. Replies to the toast were made by Major P. J. Cowan, Mr. B. Mount-Jones, and Mr. J. E. Montgomry. Major Cowan gave his impressions of the outlook for British trade in Canada as derived from his recent visit. Amongst other things, he said that our reputation and the prospects for British engineering products were good, and our prices satisfactory, but it was essential that we should make our wares more popular. At the Toronto Exhibition there were no direct exhibits of British products. There were excellent training colleges in Canada, but engineering students had to go into the United States for their practical training, where they imbibed American methods and organisation and used American machinery. Why, he asked, should not these students come to this country for their practical training? Mr. Montgomry, in his reply, referred briefly to the work which the special sub-committee of the Institution was doing with regard to co-ordination of examinations and studies, and the admission of holders of national certificates to the Institution. Mr. W. H. Patchell proposed the health of the Chairman, and Mr. Massey's reply brought the evening's proceedings to an end.

A Balanced Worm Gear Drive for Ship Propulsion.

IN an article published in THE ENGINEER of March 31st, 1922, we described and illustrated the H.R. worm reduction gear, as applied to a motor car starting and lighting set. Considerable development has since taken place in the application of the H.R. system of worm driving, and in the following article an account is given of a new patented type of balanced drive worm gear which has been built by the H.R. reduction gear department of J. Stone and Co., Ltd., Deptford, for a stern wheel oil engine driven paddle vessel, the Lord Kitchener, operating on the Nile. The further application of balanced worm drives for twin-screw propulsion machinery is also illustrated.

The gear shown in the accompanying engravings, Figs. 1 to 3, was built to the order of Vickers-Petters, Ltd., of Ipswich, for the Sudan Government, and was tested by the Sudan Government engineers. It is employed to reduce the revolutions of a four-cylinder 100 B.H.P. Vickers-Petters oil engine from 375 to 25 r.p.m. In Fig. 1 we show the completed gear with the engine drive to the left and the low-speed shaft with its flexible coupling at the centre of the gear-box. The oil pump and strainer cartridges box may be seen at the right-hand end of the

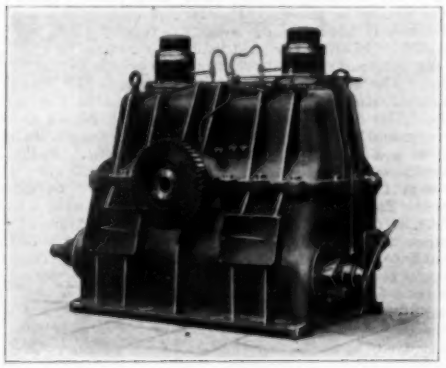


FIG. 1—H.R. BALANCED WORM DRIVING GEAR

gear-box. Fig. 2 shows sectional elevations and a plan of the gear, whilst in Fig. 3 a view of the gear-box with the upper part removed is reproduced in order to show the robust character of the large pitched slow-speed worms and worm wheel. The same view also shows the two light inspection doors which are arranged at the front of the gear-box for the purposes of giving access to the high-speed worms and worm wheels.

Referring to Fig. 2, it will be seen that the 3in. diameter high-speed shaft carries two worms A and B, which mesh with the worm wheels C and P, mounted on the two vertical spindles at the enlarged centre of which the two worms E and F are formed. The slow-speed worm wheel G, mounted upon the central 6in. diameter shaft, is driven on both sides of its periphery, and its power-transmitting capacity is thereby doubled, as twice the number of teeth are constantly in mesh than would be possible with an ordinary single contact worm drive. It will be also clear from Fig. 2 that the two worms E and F meshing with the worm wheel G must rotate in opposite directions, so that the worm wheels C and D at the bottom of the two shafts have to be cut with opposing leads. With opposed leads the thrusts of the two high-speed worms A and B are in opposite directions and counterbalance each other, which means that the high-speed worm shaft is free to move in a lateral direction, and to take up any required position. With such a floating shaft the makers claim that any inaccuracies either in gear-cutting machinery or assembling are compensated, and a truly balanced drive is obtained. From the illustration shown it will be seen that the adoption of this principle gives a considerable saving in space compared with reduction gears of other types designed for a similar output. It is also claimed that with this type of drive a minimum number of teeth on a wheel of given diameter may be employed, as the final gear ratio is a product of the high-speed and slow-speed pair of gears. As will be seen from Fig. 3, a worm with a very steep pitch is employed, which is advantageous in gears that have to sustain shock loads. With the large pitch used there is, it is claimed, practically no possibility of tooth distortion. With lead angles of from 30 deg. to 45 deg., it is recognised that with high-class workmanship worm gears can be obtained with efficiencies up to about 95 per cent. As shown in Fig. 2, the slow-speed shaft is housed in bearings of large area and thrust bearings of the ball type are provided, one on either side of the final worm wheel, to take any side thrust. As the wheel is driven from opposite sides, the main shaft bearings are relieved of all load other than that which may be applied outside the gear-box. The thrust bearings for the two vertical shafts are arranged at the top of the gear-box and automatic lubricating arrangements are provided. In the centre of the gear-box cover an air vent fitting is provided. An important consideration with regard to the thrust bearings is that all of them are used in connection with the slower running shafts, and are therefore stressed lightly, which increases their durability. Attention to such points in design has assisted, we understand, in producing very quiet running gear.

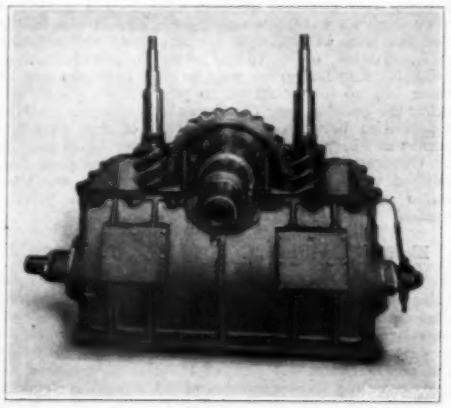


FIG. 3—THE GEAR WITH COVER REMOVED

The gear we have illustrated was subjected to lengthy and exhaustive tests at the engine makers' works, with, we understand, every satisfaction. The efficiency of the gear was shown to increase as the test proceeded, and the temperature rise on the gear-box after a full-load run of thirty-six hours was only 30 deg. above the temperature of the surrounding atmosphere. Similar gear drives to the one we have described are built for water turbines, electric capstan drives, rolling mills, crushing plant, haulage gears and other heavy-duty drives, as well as all classes of marine applications.

In the left-hand bottom corner of Fig. 2 we show diagrammatically a modified arrangement which is also covered by the patents under which the balanced gear drive is built. It provides for a final worm wheel, which is driven from both sides of its periphery, the power being supplied by two prime movers such as would be the arrangement in a single-screw vessel. In a drive of this type designed for a total output of 500 B.H.P. the length of the gear case would be about 5ft., with a depth from back to front of 4ft. 5in. The centres of the two prime mover shafts would be about 7ft. 3in., and about 2ft. 10in. above the underside of the base plate. Such an arrangement

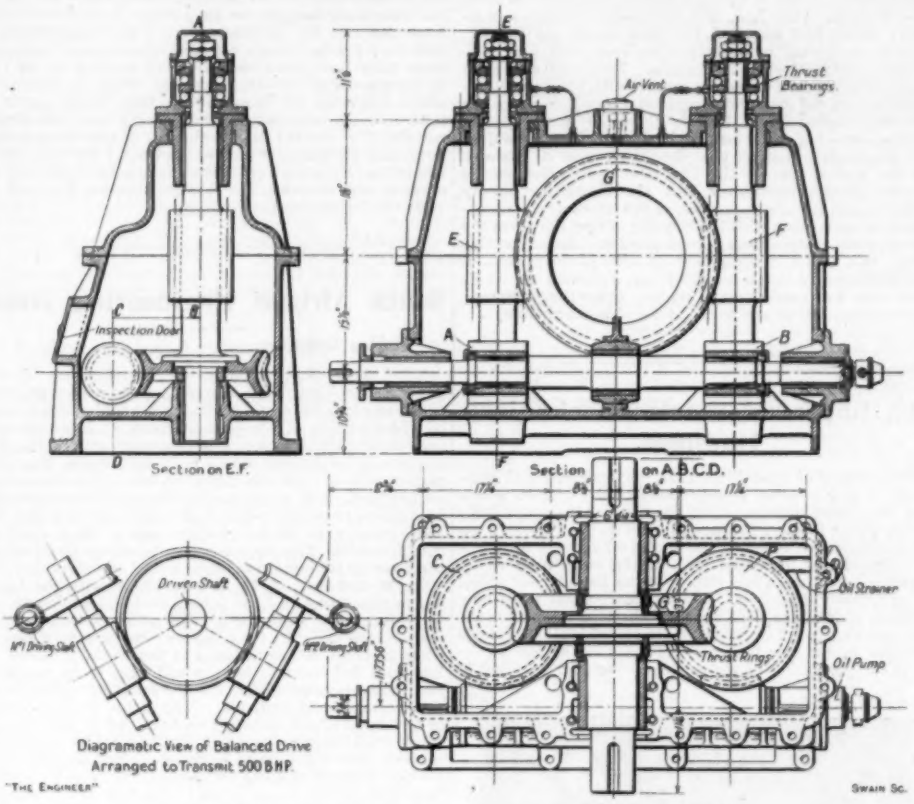


FIG. 2—ARRANGEMENT OF H.R. BALANCED WORM DRIVING GEAR

would seem to open up distinct possibilities in connection with marine steam turbine drives and oil engine drives for single-screw ships.

Electric Ploughing.

As announced in our last issue, on Thursday, December 1st, Mr. Borlase Matthews read a paper on "Electric Ploughing" before the Institution of Electrical Engineers, illustrated by interesting cinematograph films showing British, French, and German practice. Electric ploughs, Mr. Matthews said, could be usefully employed for various purposes for 200 days in the year. While it was often stated that English fields were too small for electric ploughing, the round-about or tractor types of ploughs were quite suitable for small fields; in fact, some electric ploughs of that kind were in use in vineyards in the South of France. The author's experimental work had been carried out with a view to solving the problem of the small farmer who was not inclined to co-operate in the use of larger sets.

The efficiency of the present-day plough, Mr. Matthews went on to say, was very low, and there was no scientific information available to enable any definite conclusions to be drawn as to what was needed to produce the best results. In England alone there were several hundred different designs of ploughs, and very few of them were suitable for hauling at a speed greater than that of horses. It was only during the last few years that engineers had seriously taken up the question of ploughing at higher speeds. One of the advantages of electric ploughing was that practically unlimited power was available. Any obstruction within the capacity of the plough could be broken up and, what was more important, the speed of ploughing was more constant, with the result that the work was more perfect and a greater number of acres could be ploughed per day. Very deep ploughing was also possible, a matter of considerable importance in connection with sugar beet growing. The cost of ploughing an acre of land with an electric plough was considerably lower than that of ploughing with the aid of engines. There was a considerable saving in labour, because the work of transporting fuel and water was eliminated. Professor Fletcher, of the University of California, had calculated that, on an average, 24 per cent. of wheat, 67 per cent. of oats, and 44 per cent. of hay produced on a farm were used for feeding the working animals, and if electric power were used all that produce was available for sale. It was possible to carry out ploughing in weather that would not permit horses going on the land at all. Great regularity in the ploughing could be obtained, thus giving a flat surface on which water would distribute itself evenly. The electric motor drive was simple as compared with that of a steam or oil tractor plough. Electric haulage wagons could be operated on sloping ground, where steam haulage could not be employed. Electric ploughing was a great advantage in the development of a rural distribution system, and should be encouraged by all engineers interested in rural electrification. If combined with scuffling and trashing it provided a steady load throughout the autumn, winter and early spring.

Methods of electrical distribution and of tapping lines were described, as were also the principal types of electrically-operated ploughs in use, including the large double-

winder steel rope machines and the small class of plough suitable for the individual small farmer or market gardener. Rotary tillers were also briefly described.

A very interesting development in the practical application of electric ploughing, Mr. Matthews said, was the action of the electricity supply undertakings which were distributing current in the agricultural area some 30 miles around Paris. They had, he said, formed a separate company, which had acquired the business of the existing electric ploughing co-operative societies and had purchased additional electric ploughs. They had also established a number of operating centres with housing accommodation for the men and garages and repair shops for the electric ploughs. With those facilities they were meeting the requirements of the farmers in the area in an organised and businesslike manner that should serve as an example for the rest of the world. The close association of the electric plough contractor and the electricity supply undertakings naturally facilitated the necessary arrangements in connection with the running of new lines and the development programmes of both parties. An interesting thing, too, was the equipment of some of the ploughing sets with electric lamps for signalling, &c., with the result that work was carried on at night. Once the ploughing season started there was no stop for Sundays or holidays.

An Improved Electro-Mechanical Hammer.

IN our issue of June 26th, 1925, we described and illustrated a new type of electro-mechanical hammer, which was then being introduced by the Kango Company, Ltd., of 78, Petty France, Westminster, S.W. 1. Recently we were afforded an opportunity of inspecting and testing a re-designed and improved form of the same tool, which differs in some important respects from the hammer which we previously described. It also incorporates some new features which have been suggested by two years of working experience. The principle upon which the Kango hammer works may be briefly summarised as follows:—In the upper casing of the hammer—see Fig. 1—there is

FIG. 1—ELECTRO-MECHANICAL HAMMER

a high-speed electric motor of the universal type, which may be worked either with direct or alternating current. On an extension of the motor shaft is a pinion which drives two bevel wheels running in opposite directions. These wheels are furnished with opposed balance weights, and they are housed in a floating frame, so that, as they revolve, a definite reciprocating motion is imparted to the floating frame by the unbalanced forces, such motion being transmitted to the striker shown in the upper part of Fig. 2.

In the hammer, as originally designed, there was a short transmitting piece, which was attached directly to the

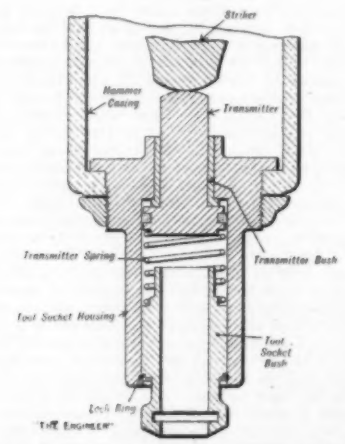


FIG. 2—ARRANGEMENT OF HAMMER HEAD

tool socket bush, with the result that the hammer was continuously in operation when the motor was running, and the vibratory motion was felt by the operator, whether or not the tool was in actual use. The drawing reproduced in Fig. 2 shows the improved form of construction adopted in the re-designed hammer, from which it will be seen that a new type of transmitter has been introduced. It is carried and guided in a bush in the tool socket housing, and a spring is interposed between the face of the transmitter and the tool socket bush. The arrangement is such that the hammer is allowed to idle until such time as the tool is actually pressed against the job.

When running light we found that there was no chattering whatever, and no blow was struck in the hammer casing. The new design of tool-holder with its ½in. diameter socket and 2½in. of supported shank has increased the output of the wall drilling tools, we are informed, by about 50 per cent. Another new feature which we noted was the robustly constructed switch in the handle. The switch has now been designed so that every part of it is easily inspected and the component parts are standardised, so that they can be quickly repaired or renewed. Some new tools have been introduced for wall drilling up to 1¼in. in diameter, and for stone dressing, while, in addition to metal chipping, the hammer has been found useful for light riveting, especially when working with non-ferrous metals. The current used is about a quarter of a unit per hour, and the hammer motors are wound for 110, 200 or 220 volts. By using a calibrated resistance supplied by the makers, any intermediate voltage between 110 and 250 volts can be conveniently employed.

South African Engineering Notes.

Stoping Efficiency.

THE *S.A. Mining and Engineering Journal* recently furnished some convincing figures to show the progress made in stoping efficiency on the Rand mines by the adoption of the jack-hammer, while at the same time stating that the saving of labour effected by the jack-hammer is not by any means fully developed. The latest performance of these machines has left the previous record well behind. Two machines in a Rand mine worked fifty-four shifts, or twenty-seven shifts each, during which time 2365 holes were drilled, an average of 43·8 holes per machine shift. The ground broken totalled 653·5 fathoms, the average fathoms that were bored per machine shift being no less than 12·1. A comparison with the days of the hammer boy and the piston drill will enable an idea to be formed of what the present performance means. A fair average per shift for a hammer boy was 0·08 fathom. Thus to break 653·5 fathoms in the working month not less than 302 hammer boys would have to be employed, and to accommodate them there would have to be at least twelve stope faces available. With piston drills an average of 0·6 fathom can be taken as fair, and to get the same result would require forty 2½in. drills and at least ninety-six natives. The drills would be studded along ten stope faces. To-day, instead of using 302 hammer boys or 96 machine boys with about 7 tons of drills and rigs, it is possible to put in the holes necessary to break over 9000 tons of ore in two faces in the working month with four boys and two machines weighing 1 cwt. The comparison brings out sufficiently clearly what is meant by stoping efficiency and throws a searchlight beam on the source of at least a part of the industry's rejuvenation.

Some Irrigation Failures.

Drastic writing-off on existing irrigation schemes is to be urged by the Irrigation Commission during the present session of the Legislative Assembly. During the year ended August 31st, 1927, the Commissioners travelled almost 25,000 miles in examining sixty-two existing irrigation schemes. After weighing up each scheme on its own merits with due regard to the amount of water available, the climate, the crops that might be grown, the distance from the nearest market, and the productivity of the soil, they came to the decision mentioned above. If drastic write-offs are not carried out then the farmers will go bankrupt in trying to pay their water dues. This course has not been rendered necessary because of the failure of the scheme owing to silting up or other similar troubles in all cases. In the case of the Cape ostrich farming districts a very high water rate was imposed, but as the feather boom was then at its height farmers could well afford to pay it. To-day, owing to the slump in ostrich feathers, ostrich farming has given way to crop farming, and the farmer can no longer afford to pay a high water rate. During the ensuing year the Commission intends to divide its activities between the inspection of new irrigation schemes and investigations into the properties of the soil. The Government Division of Chemistry has now been equipped with the necessary apparatus, and the Commission can therefore go thoroughly into a pressing question.

Electricity in the Cape.

The Electricity Supply Commission, in arranging to give a supply to the Cape Explosive Works factory near Somerset West, nearly 30 miles from the Commission's power station at Salt River, has taken a further step in the extension of the supply of electricity in the Cape rural areas. As in the case of other rural districts, the supply, pending the completion of the Salt River station, is being taken from the Cape Town Corporation's power station in Dock-road *viâ* the Electricity Supply Commission's 33,000-volt transmission line, from a sub-station at Maitland, at which point the Corporation's 12,000-volt supply is stepped up to the higher voltage. The supply is taken by the Cape Explosives Works at 6600 volts from a sub-station. Ordinarily the consumer's power station will be run in parallel with the supply and be so operated as to provide the peak demands of their works, so that the supply taken from the Electricity Supply Commission will be in the nature of a steady base load on the rural district supply system. It is anticipated that supplies to the Railway Administration's quarry at Bellville and to the Corporation's quarry at Brackenfel will be commenced forthwith.

Gold Mining Costs.

There appears to be at last a very general tendency in the mines to make the cost per ounce of gold produced the objective, and not the cost per ton milled. The Inspector of Mines at Brakpan alludes to this in his annual report and also states that "the method of excavating the reef and waste rock separately in developing as well as in stopes is being adopted wherever possible upon a number of mines in the Brakpan area. By adopting this resuing system carrying all the stopes at a minimum width obviously the cost per ton will increase and also the cost per ton of ore developed will be higher; but, equally obviously, the cost per ounce of gold won will be less than working to the now to be hoped outlived fetish of the cost per ton method. Machine drilling efficiency is still improving. This increase in footage drilled per machine shift has been brought about by (*a*) reduced size of holes drilled; (*b*) better steel in quality, tempering, and shape of bit; (*c*) increasing the length of the drill shank from 4½in. to 7½in.; or (*d*) by the use of the self-centring Siebert-Warren chuck device. Concurrently with this increase in machine efficiency the maintenance cost per machine per shift appears to be less than heretofore."

World's Leading Copper Mine?

Taking the magnitude of the deposits and value of ore reserves, the Union Minière du Haute Katanga, with its 200-mile belt and copper in sight to the value of £300,000,000, lays claim to be the world's leading copper mine. Quite recently the Union during one particular week is reported to have led all the copper mines of the world in output. With the new reverberatory furnaces at the Panda mine of this company coming into commission the output should very shortly be 20,000,000 lb. per month, and when the first unit of the new electrolytic leaching plant comes into operation the monthly production should be increased to 25,000,000 lb. Later, it is anticipated, the output will probably rise to close on 200,000 tons per annum, or over thirty million pounds per month. The Union is, in fact, only now getting into its stride, and as production increases costs will come down. Up to date 50 per cent. of the operating charges have been made up of transportation costs, but with the completion of the Lobito Bay and Bas Congo lines these costs will be greatly reduced.

Road Motor Services.

The Railway and Harbours Administration states that between April 1st and August 31st, 1927, new road motor services representing a mileage of 588 were put into operation. Since the latter date eight further services, involving a mileage of 358, have been introduced. Numerous other routes are authorised, and will be opened as soon as vehicles arrive. "Karrier" six-wheeled motor vehicles are proving invaluable in negotiating rough and "lumpy" country. Often a "Karrier" lorry is seen with the leading pair of hind wheels mounting an ant heap. The axles are completely out of line, but, notwithstanding that, all wheels are in contact with the ground, and this contact is maintained in similar manner when the rear pair of wheels is coming over the ant heap. So far, British makes of lorries hold this field, other types being the Leyland, of which the Lion and Lioness are the most used; and the Albion, the latter also seem to be in the majority in the case of motor omnibuses in the towns, though the Leylands are also employed in large numbers. So fine is the Administration running these services that despite the thousands of miles which are being operated, the latest figures show a profit of only about £700 on a revenue of between £60,000 and £70,000.

Government's Share of Mine Profits.

No less than eleven gold, diamond, copper and tin companies contribute directly to the revenue of the Union Government for the lease of ground, based on participation in profits. The largest contributor is the Government Gold Mining Areas Company, which up to March 31st of this year paid as large a sum as £8,193,072 to the Government as its share of the profits of the company. The second largest contributor was the Premier Diamond Mine, which paid £7,391,554 up to the same date. New State Areas came third with £734,733 as the Government's share. Springs Mines were fourth on the list with £717,550 paid to the Government. Brakpan Mines have paid £463,202; West Springs, £220,479; the Messina Copper Company has paid £78,547 to date; and the Zaaiplaats Tin Company comes next with a contribution of £67,598; Modder East paid £12,690; the Simmer and Jack, £3858; and the Sub Nigel, £300 to the same date. The Sub Nigel will, no doubt, in time become a larger contributor to the public revenue as the terms of the lease fix the Government's interest at 2½ per cent. of the annual profits, less amortisation allowance, for the first four years from May 31st, 1926, and thereafter according to a sliding scale.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to announce that Messrs. William McGill, Ian C. A. Murray, and A. M. MacTaggart, all of whom have been engaged in different departments of the business for many years, have been elected as additional directors of Balfour Beatty and Co., Ltd.

MAJOR-GENERAL SIR FREDERICK HUGH SYKES, G.B.E., K.C.B., C.M.G., has joined the board of G. D. Peters and Co., Ltd., and its associated companies, the Consolidated Brake and Engineering Company, Ltd., and the British Power Railway Signal Company, Ltd.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon—December 5th—Sir Arthur Keith, Treasurer and Vice-President, in the chair. The special thanks of the members were returned to Sir Ernest Moon for his donation of £500 to the Research Fund. Mr. W. H. Barnes, Mr. R. D. Blattner, Miss C. M. Demuth, Mr. E. M. Fraser, Mrs. Freeth, Mr. H. W. Hammond, Mr. A. L. Harrison, Mr. W. P. Jesse, Dr. Lloyd, Mrs. McWilliam, Mr. R. W. Marriott, Mr. A. W. Mond, Mr. H. Mond, Mr. J. G. Nicholson, Mr. R. North, Mrs. Riviere, Mr. F. W. Shurlock, Mr. L. H. Swinbank, and Mr. G. I. Taylor were elected members.

THE JUNIOR INSTITUTION OF ENGINEERS.—It is the practice of the Institution periodically to hold meetings at which any questions or discussions of engineering interest may be raised by the members. The effect of these meetings, one of which was held on December 2nd, is, not only to supply information to those members who seek it, but also to indicate to the management of the Institution matters which might usefully form the subject of future papers or lectures. Some of the topics discussed at the last meeting had reference to high-pressure steam—arising from the previous week's lecture by Mr. L. P. Perkins—water cooling of pistons in Diesel engines, waterproofing of concrete hoppers, refrigeration cabinets and artificial silk machinery.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THERE has been a little more activity on the Birmingham Exchange this week, Midland iron and steel masters having experienced a slightly improved call for their products. It has not been of any magnitude, however, and did not justify any endeavour to obtain better prices. Improved sales of pig iron and structural steel have been made, and producers are cheered into hoping that this new call for material is something more than another "flash in the pan," such as has been experienced on several occasions during the past six months. They would like to believe that it heralds a steady buying movement. On 'Change to-day the market tone was moderately bright, optimism predominating.

Pig Iron Improvement.

There has been an improvement in buying of pig iron this week. Some of the local foundries find themselves in a better position as regards work, and they have come on to the market for raw material. Having exerted a good deal of pressure for lower prices last week without avail, they have this week placed their orders at the ruling figures. For Derbyshire No. 3, £3 5s. 6d. to £3 6s. was paid; while Northamptonshire foundry changed hands at £3 0s. 6d., and in a few cases £3 1s. If the improvement at the foundries proves a reality, it is a particularly good sign, for this is not a period of the year when a new market inspiration is to be expected. Buying during the past few months has been very sporadic, however, and the improvement may turn out to be nothing more than a buying spurt of the same character as those which have previously made themselves evident. Business is as dull as ever in the forge department, and it is quite probable smelters would accept something below the generally quoted figures for even moderate tonnages. The reduction by Middlesbrough furnacemen of No. 3. G.M.B. to £3 5s. has not resulted in any appreciable increase in business from this district. Midland smelters have no difficulty in securing adequate tonnages of blast-furnace coke. Ovenmen have difficulty in disposing of their production, and values are none too strong, though recent prices continue to be quoted.

Staffordshire Iron Trade.

The Staffordshire iron trade continues poorly employed. Marked bars at £13 are required to some extent for engineering purposes, but there is no reserve of orders of any account. Staffordshire Crown bars are still quoted at £10 5s. to £10 10s., some of the makers being firm at the latter price. Strong competition is complained of with Lancashire, where it is said that bars are sold at £9 10s. This is not the lowest market price, however, for unmarked bars, of Crown quality, from other districts, have changed hands at £9 7s. 6d. Nut and bolt iron continues almost unsaleable. What business there is goes to Belgium, it being impossible, manufacturers say, to pay the price Staffordshire makers ask, and still produce bright bolts and nuts or hurdles at a competitive price. Some of the tube makers are fairly well employed, and wrought iron tube strip is in slightly better demand.

Steel.

Business in the steel department remains dull, orders being small and infrequent. The improvement noted last week in the call for structural materials has not gained impetus. Plate mills have benefited by a few orders given out this week, but they are not of sufficient volume to insure continuous operations. The steel trade will eventually benefit by some orders recently given out to rolling stock works in Birmingham, but at the moment specifications are badly needed. Values have undergone no change during the week, nor is it thought likely that any important alteration is likely to be made this side of Christmas. Continental competition in finished material is keen, joists being offered in this district at £4 10s. 6d. f.o.b. Antwerp, and plates at £6 7s. 6d. It is complained that Germany is sending finished tubes into this country cheaper than they can be made here, whereas that country used to export the tube strip only.

Galvanised Sheets.

In the galvanised sheet trade values are weak, some shading of the £13 5s. figure for 24-gauge corrugateds being reported. There is a general scarcity of orders. Business in the export side remains very slack. District manufacturers are not disposed to follow prices down to their lowest level, and many of them still quote £13 7s. 6d. At some of the mills production has been reduced to the level of current demand. Quick delivery can be got of all the standard sizes.

Scrap.

Sales of scrap have been so poor of late that many Midland merchants this week have reduced their quotation by 1s. 6d. per ton, quoting £2 18s. 6d. delivered South Wales. Even at this price they are experiencing great difficulty in selling material.

Ironworkers' Wages.

Midland ironworkers' wages, which are regulated by the sliding scale under the Midland Iron and Steel Wages Board, were reduced 5 per cent. from Monday last, December 5th. Throughout the year wages have gradually dropped lower and lower. The latest fall following reductions of 2½ per cent. in October, 5 per cent. in August, 2½ per cent. in June, and 5 per cent. in April, makes a total drop of 20 per cent. this year. Wages are now 35 per cent. above the puddling base rate of 13s. 6d.

The Proposed New Australian Tariff.

Iron and steel masters in the Midlands who export to Australia are giving very serious consideration to the proposals for the amendment of the Australian tariff. Many iron and steel masters in this district will be prejudicially affected should the Commonwealth Government, as is expected it will, approve them. It is understood that it is suggested that the rate for exports from Britain of "bar, rod other than wire rod in coils, angles, tees," &c., should be raised from £2 4s. to £3 10s. per ton. The general tariff is to remain at £6, and the intermediate rate for foreign countries, subject to negotiation, at £5. Railway and tramway rails from the United Kingdom are in the proposed amendment increased from £1 15s. to £2 10s., the intermediate and general tariffs remaining at £4 5s. and £5. Rolled iron or steel beams, channels, joists, girders, columns, trough and bridge iron, and steel on which the tariff was £2 8s., will, if this revision is adopted, be £3 10s., the imposts for foreign material in this class remaining at £5 and £6 5s. It is the concensus of opinion that the proposed increases in tariffs come at a most inopportune time, and are bound to have a serious effect on exports to Australia.

Metallurgists' Annual Dinner.

Members of the Staffordshire Iron and Steel Institute, the Birmingham Metallurgical Society, and the Birmingham local section of the Institute of Metals, attended the second annual dinner arranged by the Co-ordinating Committee and held at the Queen's Hotel, Birmingham, on Saturday last. Dr. Douglas H. Ingall—chairman of the Co-ordinating Committee—presided, and was supported by the respective Presidents of the co-ordinated societies, the Vice-Chancellor of Birmingham University—Mr. C. Grant Robertson—and Mr. G. N. Guest—President of the Birmingham Chamber of Commerce. During the evening Mr. E. M. Boote—past-President—was presented with the Birmingham Metallurgical Society's medal by Mr. W. R. Barclay, who paid tribute to the worth and work of Mr. Boote to the Society and to metallurgists generally.

Railway Traffic Rates to Newport.

Midland manufacturers express satisfaction with the terms of the withdrawal of the application to the Railway Rates Tribunal by the Newport Corporation, and others for a modification of the railway goods rates between Newport Docks and the Midlands. The assurances given by the London, Midland and Scottish and Great Western Railway companies that a reduction of rates would be granted is welcome, and it is thought a considerably increased volume of export cargo from this district may now pass through Newport Docks. The terms of the assurances were that the reductions would probably cause reasonable quantities of traffic to pass where it did not pass in appreciable quantities before, and that the reductions would not be calculated to prejudice traffic now passing through the port of Bristol, or other port rates.

Electrical Firms' Activity.

Electrical firms in the Midlands are just now experiencing a fairly good run of business, and there is said to be considerable promise of further activity developing in the immediate future.

Coventry's Proposed £300,000 Water Scheme.

The Coventry Corporation proposes to promote in the next session of Parliament a Bill for effecting various objects for the improvement of the City, including a scheme for improving and extending the water undertaking, at a cost of something in the neighbourhood of £300,000 to £350,000.

Cheaper Electricity at Dudley.

The Shropshire, Worcestershire and Staffordshire Electric Power Company, as the result of representations made to it by the Dudley Corporation, has agreed to make reductions as from January 1st next in the price of current supplied to the borough.

Further Coal Losses on Cannock Chase.

It is regrettable to find that during October the loss per ton of coal raised in the Cannock Chase coalfield was 11·83d., as against 9¼d. in September, and 10¼d. in August. The coalowners' accumulated deficit since December last has now reached the figure of £735,590, compared with £555,261 and £398,000 recorded at the end of October and September. This deficit is made up partly of total loss on the working of the pits, and partly of profits to which owners were entitled.

Miners' Wages.

The wages of the miners in the Cannock Chase and Pelsall district during December are to remain, for the sixth consecutive month, at the minimum under the local agreement. This is 42 per cent. on basis rates, but the real ability of the owners to pay as shown by the ascertainment based on the working of the industry during August, September and October is only 9·89 per cent. compared with 13·90 per cent. at the November ascertainment, and 12·07 per cent. at the October one. A stallman's minimum wage per shift is therefore 9s. 4d., and for other grades of men down the pits from 8s. 10¼d. to 7s. 3d.

Hednesford Pit to Close.

The Cannock Chase Colliery Company, Ltd., in pursuance of a scheme of concentration has decided to close down the Old Hednesford Pit (No. 9), and the 345 men and youths employed have been given fourteen days' notice. For some time past the management has been concentrating on a scheme for linking up this pit with others on the Chase side of the district, and the decision to close down Old Hednesford shafts for coal raising purposes was not altogether unexpected. The pit is the oldest on the Hednesford side of the district.

Unemployment.

Following an increase of 4031 in the number of unemployed in the Midlands last week, the latest returns record a decrease of 995, bringing the total to 134,038. Birmingham and Coventry continue to show improvement, the figures having slowly fallen at both places for some weeks past. The re-absorption of labour in the Birmingham area is chiefly due to activity in Christmas season trades.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Railway Electrification.

THE projected electrification of the railway line running south from Manchester (London-road Station) to Altrincham, to which I referred a week or two ago on the occasion of the visit of inspection of Sir Josiah Stamp, chairman of the London, Midland and Scottish Railway, has again been prominent within the last few days with the publication of further details. The scheme is to link the proposed electrified Manchester–Altrincham line with the main line running south from London-road Station through Longsight and Didsbury, by means of a line starting from Cheadle or Gatley, and running through Northenden and Baguley to Altrincham. According to a statement made by a railway official, the scheme will not be completed before 1929 at the earliest, and will probably form the nucleus of a much larger project, Northwich and Chester being mentioned as towns in Cheshire which may ultimately come within its embrace. It is mentioned, incidentally, that the present scheme has attracted attention again to the question of the electrification of the Manchester–Oldham line, which was under consideration by the directors of the company a year or two ago, and it is regarded as not improbable that the latter will again receive serious consideration.

Electricity Supply.

A Bill will shortly be introduced into Parliament for the purpose of giving effect to a proposal of the Stretford—near Manchester—Council to enter into an arrangement with the Electricity Boards of the adjoining areas of Flixton, Urmston and Davyhulme for the formation of a joint Electricity Board. In 1919 the Stretford Council took over the undertaking of the Trafford Park Power and Light Company, the present undertaking ranking sixth in Great Britain from the point of view of current production.

Textile Plant for Japan.

Interest has been aroused in textile machinery circles by the announcement that Platt Brothers, Ltd., of Oldham, has received an order for the equipment of several Japanese spinning mills with ring spindles and preparatory machinery. The contract itself is said to be an important one, and the expectation is that there will be others to come from the same country, the reason for this belief being the necessity for the erection of new cotton-spinning mills in Japan in readiness for the changed conditions which will result from the compulsory cessation of night work in mills from the middle of 1929. Although by no means the most important market for British textile machinery, Japan is already an important buyer, and it is reasonable to assume that shipments thence during the next year or two will be on a much bigger scale. As a matter of interest, it may be pointed out that exports of textile machinery from this country to Japan during the January–October period of the present year were valued at £612,000, compared with £626,000 in the first ten months of last year, and £439,000 in the corresponding period of 1925, the respective quantities being 7249, 5862 and 3047 tons.

Non-ferrous Metals.

All sections of the non-ferrous metal markets register an improvement compared with a week ago. Tin has continued its steady upward movement, and values of this metal at the time of writing are the highest since towards the end of September. The demand for tin during the past week has only been on a moderate scale, but there is a decidedly firmer tone about this section of the market, due to an improvement in the statistical position, visible supplies of the metal at the end of November showing a decline on the month of about 175 tons. After the slight setback reported last week, copper has effected a substantial recovery, due to a heavy fall in the total stocks of the metal in this country, and to the fact that holders are not too anxious to sell. Electrolytic and manufactured copper has been advanced, and there has been a fair amount of buying interest displayed, especially in the latter. Lead has acquired additional strength, and current quotations are now almost back to where they were at the end of August. A fair amount of buying interest has been shown in this section, and at the moment there is no indication of renewed weakness. Spelter is somewhat stronger on balance, although, except in the case of the high-grade metal, the demand has continued on rather quiet lines.

Iron.

The prospect of any improvement in the demand for pig iron on this market before the beginning of next year seems to be fading away, and very little new business of any importance has been done during the past week. Partly because of the prevailing quietness and perhaps partly as a result of the recent reduction in Cleveland foundry iron, there has been an easier feeling in certain sections of the market of late, and some slight modifications in prices have to be reported, these affecting Derbyshire makes more particularly. For these current values

range from 73s. to 73s. 6d. per ton, delivered Manchester or equal, whilst for Staffordshire brands current offers are from 72s. 6d. to 72s. 9d. There has been some easiness also in the case of hematites, West Coast varieties being offered for delivery into this district at from 84s. 6d. to 85s. per ton. North-East Coast foundry iron is maintained at the recent reduction to 78s. 2d. per ton, whilst Scottish brands are also about unchanged on the week at 88s., including delivery in each instance. Buying interest in finished iron on this market continues at a low ebb, although there is no alteration in the prices quoted by the Lancashire Bar-iron Makers' Association, Crown quality bars being offered at £10 per ton and seconds at 10s. per ton less.

Steel.

There is promise of important new business for constructional engineers locally arising from the numerous fresh inquiries that have been reported during the last few days. At the same time, although there is a certain amount of interest being shown by users in connection with supplies of materials over the first quarter of next year, there is little disposition as yet to enter into fresh contracts for forward deliveries. Except where they are still able to specify for deliveries against old contracts, buyers are content to order for near delivery only. Sections remain at £7 12s. 6d. and tank plates at £8 7s. 6d., with boiler plates quoted at from £10 5s. to £10 10s., and steel bars at £7 10s. to £8 10s. per ton. Galvanised sheets are now down to about £13 per ton f.o.b. for the usual Indian specifications, and at this low figure there has been a certain amount of buying going on, though principally for the Bombay market. Inquiry for continental semi-finished steel has been very sluggish, and little business has been booked during the past week. A quiet trade has been done in certain varieties of finished products at steady prices. For delivery to Lancashire buyers' works, for cash against documents, Thomas plates are quoted at £7 2s. 6d. per ton, Siemens plates at £7 10s. to £7 12s. 6d., wire rods at about £6 18s. 6d., angles at £5 17s. 6d., joists at £5 12s. 6d., steel bars at £5 18s. 6d., billets at £4 18s., and sheet bars at £5.

BARROW-IN-FURNESS.

Hematite.

There is no change in the condition of the hematite pig iron market, which continues to be dull. Despite the restriction of output by the reduction of the number of furnaces in blast, stocks are still accumulating in one or two of the works. The reduction in the price of iron does not seem to have tempted buyers, and there is a feeling that some of the orders which have been coming to the West Coast are going eastwards. One large company, which has no furnaces working at the present time, is gradually reducing stocks at its two works, stocks which had assumed considerable proportions before the furnaces went out. A little pig iron is going coastwise, but the tonnage is not heavy. American business is possible, but only at a price which does not tempt many makers. Continental business is small, and home business is confined strictly to immediate requirements on the part of customers. The iron ore trade is quiet, and few mines are at work; there is practically only one in Cumberland. Foreign ore is being imported in restricted quantities. The steel trade, as far as Barrow is concerned, is rather better than the iron trade, and orders are held which will keep rail mills engaged into the New Year. The hoop department will be busy for many months to come.

Shipbuilding and Engineering.

A certain amount of optimism exists as regards shipbuilding and engineering, and Commander Craven, local managing director of Vickers Ltd., has hinted that he can see at his own works two years' work ahead for between 11,000 and 12,000 people.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Quieter.

THERE has been a slowing down of business in a number of sections of the steel trade, orders and inquiries having fallen off and instructions having been received to reduce deliveries. A good deal of this slackness is explained by the customary preparations for the end of the year. Whether it has any deeper meaning remains to be seen. There is still a good deal of optimism with regard to the future, and in some quarters a marked change in the New Year is anticipated. When some of the furnaces are shut down for the Christmas holiday the date of their resumption will be indefinite, and will depend upon the extent to which orders and inquiries are received in the meantime. The basic steel section still presents the most unsatisfactory features, and there is hardly any market for heavy basic steel scrap. A department which is able to give a somewhat improved account of itself is that which manufactures railway material. It is enjoying a rather better demand than for some time, and is receiving increased orders from South Africa and South America. The bookings from China and Siam have, however, been on a very small scale all through the year. There is little work at the wagon-building yards, and the local axle and tire plants are feeling this shortage severely. Many of the rolling mills serving the various branches of the steel trade are but moderately employed. Orders from the automobile industry, for various moving parts made of special alloy steels, are on a large scale; special steel used in the building of aeroplanes is also a good line, and there is a growing demand for stainless steel articles of many kinds for use in engineering works. The heavy foundries are not well employed.

The Lighter Trades.

There has been a falling off in the demand for files and other tools. The makers of stove grates and light iron castings for the building trade report a decline in activity. A number of the cutlery and plate factories are still well employed, but the Christmas rush is almost over, and overtime work is exceptional. The few late orders for Christmas sales which still arrive are mainly for the cheaper classes of ware. A busy season has been enjoyed by a few firms specialising on pen, pocket and table cutlery of the highest quality, but in a good many cases the report on the year's trade is that it has been far from satisfactory.

Shortage of Pipe Orders.

The making of cast iron pipes, which is a big trade with several Derbyshire firms, has been a busy department for some time, but the Staveley Coal and Iron Company now reports a shortage of orders, in consequence of which it is going on short time. Notices were posted at the company's old works last week stating that only three days a week would be worked until further notice. A few departments of the new works are also affected. Up to recently the three works of the company were engaged at high pressure, but the orders on hand have been executed and few fresh contracts have been received.

Colliery Developments.

It is reported by the Nunnery Colliery Company, Sheffield, that extensive developments are taking place. One is the installation of a new coke oven plant on the most up-to-date principles, in connection with which the company has made a contract to supply the Sheffield Gas Company with 3½ million cubic feet of coke oven gas per day over twelve years. Extensive developments are being undertaken below ground; new screening and coal-handling plant is being erected, and a contract has been entered into for the erection of a plant for the dry cleaning of coal, which will be the first plant of its type in this part of the country. An installation of pithead baths at the Handsworth pit of this company was opened on Saturday by Mr. Herbert Smith, President of the Miners' Federation. There are forty-eight cubicles where the men may have hot or cold baths before they leave the pit, and accommodation is provided for the clothes of 630 miners. The cost of the installation has been £6100. The Wath Main Colliery Company, Ltd., has placed an order with Simon-Carves, Ltd., of Manchester, for a battery of "under-jet" coke ovens, with the necessary additional by-product recovery and treatment plant. A contract has also been placed for additional drainage and storage plant.

Artificial Sunshine Clinic.

With the object of determining how far artificial sunshine can strengthen the industrial population against preventable diseases and the lesser ailments, an ultra-violet ray clinic has been built and equipped by the Sherwood Colliery Company, Mansfield. The installation, which is the first of its kind in the coalfields of this country, is the outcome of a visit of five Mansfield pit lads to Switzerland in August. They were accompanied by Lieut.-Colonel F. S. Hutchinson, of the New Health Society, and as a result of the ultra-violet treatment which they received they gained in weight from 2 lb. to 17½ lb., and also in chest measurement. The clinic has been equipped with ultra-violet mercury vapour quartz lamps and four radiant heat lamps. The cost has been £1330. It is hoped that 800 men and lads will pass through the clinic each week. In addition, arrangements will probably be made for the treatment of children of colliery workers. The clinic was opened last week-end, and was inspected by members of the New Health Society and other distinguished medical men.

New Power Station at Leeds.

A large new generating station is being erected by Leeds Corporation at Kirkstall, and, for the equipment of the first instalment of the boiler-house, the Electricity Committee recommends acceptance of the tender of International Combustion, Ltd., at the figure of £202,114. The installation now being undertaken forms one-third of the capacity of the works as at present contemplated. There are to be three boilers of the Stirling type, each having an evaporative capacity of 160,000 lb. per hour. The steam is to be superheated to 750 deg. Fah., and the blow-off pressure of the boilers will be 490 lb. per square inch. Solid forged drums with riveted ends are to be used. The boilers will work with induced draught. The firing will be by means of powdered fuel, the equipment for which is on the "Lopulco" system, with Raymond air separation type mills and rotary dryers. Included in the tender are economisers, air heaters, dust extraction appliances, and conveying plant for removing the raw fuel from barges and taking it to the pulverising house, the storage stack and the boiler-house. A provision of the contract is that all the material is to be of British manufacture, and local labour is to be used wherever practicable.

A Railway Engineering Feat.

An important bridge on the London and North-Eastern Railway—that which carries the main lines over the Great North Road at Grantham—has just been dismantled and replaced by a stronger construction. It was considered that the old bridge, built in 1852, was no longer strong enough to carry the heavy engines of the "Flying Scotsman" and "Pacific" type, and it was decided to substitute for it a double-girder steel bridge. The work was done during two week-ends. The second portion was carried out on Saturday and Sunday last, when the up lines were replaced, a girder measuring 77ft. long and weighing 38 tons being placed in position. The girder had been brought by special train from the works at Stanningley, near Leeds, to Grantham. After the work of dismantling the old bridge had been carried out—an operation which began at nine o'clock on Saturday night and occupied several hours—two powerful steam cranes approached the gap, with the girder swinging at the ends of their grapnels. The girder was fitted into its position in the record short time of seven minutes, and was afterwards riveted and cemented. The operation was carried out without the cancelling of a single train, although some had, of course, to be diverted on to the other line. The up line was clear for traffic fifteen hours after the removal of the old portion of the bridge began.

Historic Ship Dismantled.

Thos. W. Ward, Ltd., of Sheffield, has just dismantled at its Morecambe works the cruiser Glasgow, which was the only British ship to take part in both the battles of Coronel and the Falkland Islands in the Great War.

Electricity and Tramways.

Louth Town Council has decided to apply for a special order under the Electricity (Supply) Acts, authorising it to supply electricity for all public and private purposes within the borough. At Bolsover, the Urban Council has inaugurated an electricity scheme which is expected ultimately to involve an expenditure of £12,700. The electricity is supplied by the Staveley Coal and Iron Company. It is hoped to extend the scheme to Shuttlewood and Carr Vale in the New Year. At Rotherham the Tramways Committee of the Borough Council recommends that application be made to the Ministry of Transport for sanction to borrow £12,000 for the purchase of railless vehicles and £2000 for overhead equipment. Mr. G. T. Dickinson, technical assistant in the Sheffield Corporation tramways department, has been appointed rolling stock superintendent to the Rangoon Tramway and Electric Supply Corporation.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Exports Decline.

THE exports of iron and steel from the Cleveland district during the month of November reached the smallest total recorded since February last, when, owing to urgent home requirements following upon the termination of the coal strike, the shipments had to be severely restricted. Possibly in some measure the contraction of exports in November was due to the delays of shipping caused by the severe weather experienced. Nevertheless, it is disquieting to observe that the exports of Cleveland pig iron abroad have not reached 10,000 tons in any single month during the current year, and that the November total of 8302 tons represents a decline of 890 tons, as compared with October. Curiously, Belgium, a most formidable competitor, has also been Cleveland's best customer, 2620 tons having been shipped to Antwerp; but apart from 1175 tons to Sweden and 1192 tons to Denmark, the November shipments of pig iron abroad have been negligible, and point quite clearly to the fact that Cleveland iron is not yet on a competitive level on the Continent. Similarly it is not on a competitive level in Scotland, and for the month only 3059 tons were shipped to Scottish ports, whereas a normal average used to be 1000 tons per day. The manufactured iron and steel exports for the month totalled 58,405 tons, about 13,000 tons less than the preceding month. The decline was chiefly noticeable in the Australian trade and in the shipments to India and the Far East. On the other hand, a tonnage of 11,621 was dispatched to the Argentine, which represented about 4500 tons more than the previous month.

More Losses on Coal.

The low and unprofitable price at which coal continues to be sold for export is indicated by the ascertainments of proceeds and costs in Northumberland and Durham in October. In each county the owners will have to make up a heavy deficiency—even heavier than that indicated by September's ascertainment—in order to pay the minimum wage. Low as the price is, exporters are having difficulty in meeting competition from foreign producers, particularly Poland. While some of the collieries fixed up contracts at the beginning of this year at more remunerative rates than those now ruling, and have been afforded some relief thereby, a new situation will arise at the beginning of next year when fresh contracts have to be made. The ascertainment for Northumberland, which regulates wages for December, shows that but for the operation of the minimum clause the percentage on basis wages would be 31·26, as compared with 33·02 per cent. in November—a reduction of 1·76 per cent. The minimum percentage is 80, and therefore the owners have to make up a deficiency of 48·74 per cent. In Durham the percentage on miners' basis wages would be 40·65, as against 42·07 per cent. in November—a reduction of 1·42 per cent. The minimum is 89, and the owners have to make up a deficiency of 48·35 per cent.

Cleveland Iron Trade.

The general position in the Cleveland pig iron trade is unchanged, but there has been rather more activity in local transactions, and some consumers are indicating a willingness to buy forward, no doubt under the impression that, on the makers' unremunerative basis of 65s. per ton for No. 3 G.M.B., such a course is warranted. Any steady flow of forward business would, of course, greatly stabilise and improve the home situation. Meanwhile, orders for immediate delivery continue to absorb the limited output of iron. A little business has been put through the makers' direct selling agency, established in Glasgow for direct disposal of Cleveland pig iron to consumers in Scotland, but the sales are understood to have been at nearly a shilling per ton below recognised market quotations, and this has caused renewed dissatisfaction on the part of English customers, who consider that they should not pay more than Scottish buyers. Merchants are still receiving inquiries from Scotland, but are unable to submit terms, as ironmasters here will not sell to second hands for such delivery. While there continues to be little activity in the export trade, further consignments to Germany have been reported during the past week. Quotations are unchanged, No. 1 foundry iron being 67s. 6d.; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; and No. 4 forge, 63s. 6d.

Hematite Pig Iron.

Conditions are improving in the East Coast hematite pig iron trade. A good deal of the iron recently

sold has yet to be made, and the position of producers has been strengthened by the fairly substantial contracts that have been arranged, and the continued home and export inquiries. Considerable deliveries are reported to South Wales, and consumers in the immediate district are accepting better supplies; whilst there is also indication of expansion of purchasing for export. Mixed numbers of hematite are quoted at 71s. per ton, and No. 1 quality at 71s. 6d.

Ironmaking Materials.

Business in the foreign ore trade is practically at a standstill. Consumers have large stocks and deliveries to take under old contracts. The price of best Rubio ore is nominal at 21s. per ton c.i.f. Tees. Durham blast-furnace coke is slow of sale, ironmasters continuing to hesitate to pay the rates producers are very ready to accept. Consumers state that they can cover their needs on the basis of good average qualities at 17s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The Australian Government's proposal to increase the customs duty on British steel has caused some uneasiness in this district. For some time past a fairly good trade has been done with the Dominion by steelmakers in the Tees-side area, and any further increase in the import duty will, it is feared, prove a big handicap in retaining the Australian trade. Aggregate output keeps heavy, and some producers are well sold, but in certain branches contracts are being executed faster than new orders are coming forward. Demand for semi-finished materials is easier, following moderate purchasing. Continental semi-finished commodities are offered less freely. Finished steel that comes under the rebate scheme to firms using solely British products is selling fairly well, but export business is quiet. Quotations all round are unaltered.

The Coal Trade.

The outlook to the end of the year is not very encouraging, and only in odd instances is there any firmness in values. There are inquiries for the first quarter of next year, and offers have gone in for considerable quantities of foreign business, but little hope is held out that they will result in business in consequence of the exceptionally low prices quoted on the Continent. Northumberland steam coals are erratic. Some sections are busy for prompt, but have only moderate trade in prospect ahead; while other steam-coal producers find a slow position generally. Fitters quote 13s. 6d. to 14s. for best steams, but concessions are possible from second-hand holders. Durhams are also quiet generally. There is a fairly good demand for coking unscreened best qualities at 14s., but there is an abundance of other descriptions at 13s. 3d. to 13s. 6d. Durham gas coals are quiet, but demand, whilst keeping up to the recent average, shows no special signs of increasing, and producers have still to limit output to actual orders on hand. Best qualites are quoted at 15s. 6d. to 15s. 9d., and seconds at 13s. 6d. to 14s. The bunker trade is quiet. The demand is limited for the coaling stations, and for ships' use there is no special activity. Good ordinary kinds are plentiful at 13s. 3d. to 13s. 9d.; best are in good supply at 14s. to 14s. 6d.; and special rather scarce at 15s. The coke position is irregular. Gas coke is heavily sold and well stemmed by makers, but through contractors supplies are offered cheaply, subject to getting loading turns. Up to 24s. 6d. is quoted for gas coke. Patent oven cokes are quiet and in ample supply at 17s. to 18s.; special makes and beehive, 24s. to 30s.

More Work for Shipyards.

Tyneside shipbuilders have participated in more contracts which have been given out. Palmers Shipbuilding and Iron Company, Ltd., Jarrow and Hebburn, has received an order from the Gulf Refining Company, of Philadelphia, U.S.A., for three more oil tankers of about 2400 tons deadweight each. The Jarrow firm has built similar vessels into double figures for these owners. Swan, Hunter and Wigham Richardson, Ltd., have also received an order from the Hungarian Levant Company for a new cargo vessel of between 6000 tons and 7000 tons deadweight. The vessel will be built at the firm's shipyard at Southwick, and it is understood that the engines will be constructed by the North-Eastern Marine Engineering Company, Ltd., Wallsend.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE Clyde output for last month constituted a record for November, although it had been exceeded in other months in preceding years. The total of twenty-six vessels of 74,119 tons aggregate is also the highest for any month for this year to date. As was the case in September and October, the figures for November convey an erroneous impression of the state of the industry. The large output during the last three months is almost wholly due to the fact that many vessels held up during the coal strike last year reached launching stage within those months. The yards are busy and will probably continue so throughout the winter, but the recent rate of output cannot be maintained unless the rate of bookings of new contracts is accelerated. The figures for November were largely made up by the launching of one vessel of 21,000 tons and two of over 10,000 tons, and three between 5000 and 6000 tons, as follows:—Duchess of Atholl, twin-screw turbine, 21,500 tons, for the Canadian-Pacific Railway Company; Victolite, twin-screw motor tanker, 12,000 tons, for the Imperial Oil, Ltd., Toronto; Beaverhill, twin-screw turbine, 10,000 tons, for the Canadian-Pacific Railway Company; Rancher, cargo, 5900 tons, for Messrs. T. and J. Harrison, Liverpool; Nimoda, cargo, 5000 tons for the Ham Steamship Company, Cardiff; and the Jaladuta, cargo, 4966 tons, for the Scindia Steam Navigation Company, Bombay. The list also included the twin-screw turbine steamer Duke of Lancaster, 3500 tons, built for the London, Midland and Scottish Railway, and numerous smaller craft. Contracts announced during the month of November include a cargo steamer of 10,000 tons deadweight and three other cargo steamers of between 8000 and 9000, 8500 and 6700 tons respectively. Scottish shipbuilding returns for November included the launching of the cargo steamer Westbury, 6124 tons, from the yard of the Burntisland Shipbuilding Company on the river Forth, for the Alexander Shipping Company, London.

Steel.

So far as actual business is concerned, there is no apparent change in the steel market. Outputs of heavy steel are moderate, but there is a continued shortage of specifications for shipbuilding and structural material, and the outlook is still very uncertain. Steel sheets are quiet, and the export prices of galvanised descriptions are subject to concessions.

Australian Tariffs.

Considerable anxiety has been caused in this district by the intimation of proposed increased duties on imports of certain materials to Australia. Makers of bar iron, steel rails and steel structural material are most directly interested, the tariffs on these under the scheme being heavily increased. Full details have been asked for through the Australian Association of British Manufacturers and their representatives. Few concerns here have yet had intimation of the change from their connections in Australia. The position with regard to Scottish tubes is somewhat different, as some time ago it was announced that Messrs. Stewarts and Lloyds, the large tube producers, were arranging to establish tube works in Australia. The proposed increase on iron and steel tubes is from 27½ to 40 per cent. for British and from 40 to 60 per cent. for foreign; the first figure in each case being the present rate.

Iron.

The bar iron makers have not so far gained any benefit from the latest cut of 10s. per ton in the home price, and the position is not improved by the quietness in the re-rolled steel department of the industry. The home price of re-rolled steel bars is £7 15s. per ton. The export quotations for both iron and re-rolled bars, nominally £8 and £7 per ton respectively, are open to adjustment when a good order is in prospect.

Pig Iron.

The pig iron market is unchanged, and with stocks increasing the tendency is still weaker.

Exports and Imports.

Imports of iron ore were light, only amounting to 5700 tons. Iron and steel to the amount of 1900 tons were discharged. Exports of iron and steel only totalled 2800 tons.

Coal.

The feature of the market is the strength of best Lanarkshire splints, the scarcity of which has caused some improvement in second qualities. Best ells also are comparatively firm. Lothians steams are only steady, but Fifeshire steams are comparatively busy. Fresh export business is extremely slow and any firmness apparent in this market is almost entirely due to the covering of sales due for dispatch by exporters prior to the holidays. Apart from double nuts, all sizes of washed materials are weakening. Aggregate shipments amounted to 262,450 tons, against 242,650 tons in the preceding week and 259,078 tons in the same week in 1925.

State of the Coal Industry.

At a meeting of the Colliery Firemen and Shot Firers' Association the state of the mining industry was under discussion, when it was reported up to date 178 mines had been abandoned, 56 temporarily abandoned, and, in addition, work in many sectors had been stopped.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

SHIPMENTS of coal from this district for the week ending the 2nd inst. amounted to nearly 434,000 tons, and were, in fact, rather more than 26,000 tons better than for the preceding week, yet the conditions in the coal trade were very unsatisfactory, and it is not surprising to find that further stoppages at pits have taken place. As a matter of fact, the loading position at the docks last week created a record for the number of tipping appliances which were rendered idle owing to the lack of ready tonnage. The figure on Saturday last reached the extremely high total of fifty-seven. No doubt a certain amount of tonnage had been delayed by the fog and bad weather prevailing, but even as the result of steamers arriving over the week-end the total of idle tipping appliances on Monday was as much as thirty-nine, which is much heavier than has been the case for the first day of the week for some time past. Unfortunately, it cannot be said that there are any real hopes of an improvement in the situation for the next few weeks, as the amount of chartering of late has fallen off, and there does not appear to be the business about for prompt loading. There are, however, a few fresh inquiries for supplies of coal ahead, it being understood that the Brazilian Railways are in the market for 160,000 tons of coal, consisting of two-thirds large and one-third small, for delivery over the whole of next year, and that one of the French railways has asked for prices for 200,000 tons of large coal. The Belgian State Railways require offers for 40,000 tons of large, through and small coals for delivery over the first quarter of 1928, and the French Marine wants prices for 13,000 tons of large coals for immediate delivery. The Spanish Navy authorities are reported to have bought 12,000 tons of best large for prompt shipment, and the Spanish M.Z.A. Railways to have contracted for 60,000 tons of best large for delivery over the first three months of next year.

Egyptian State Railways.

In addition to the business mentioned above, news is now awaited respecting the contract for 100,000 metric tons of Welsh large for delivery at Alexandria for account of the Egyptian State Railways during the first four months of next year. More than ordinary attention is generally given to this business. Tenders had to be in at Cairo on the 1st inst., and the offers have to hold good for ten days. It is not improbable that the railways may purchase more than the 100,000 metric tons for which they sought prices, considering the low figures which have been tendered. The lowest price was 27s. 2d. net c.i.f. Alexandria, sent in by Messrs. Watts, Watts and Co., their nearest competitors being Messrs. Pyman, Watson and Co., and Messrs. Milburn and Co. at 27s. 7½d.; while other offers ranged up to 28s. 9d. Messrs. Watts, Watts and Co. secured the last order for 125,000 metric tons in September, when their price was then 1s. above their present tender. It shows how prices have fallen when it is recalled that for the coals which these railways received from March to May last the price was 33s. 5d. net c.i.f., there being therefore a drop of 5s. 3d. per ton compared with the lowest tender now sent in. It is generally agreed, however, that the figure of 27s. 2d. net c.i.f. Alexandria leaves little or no margin for profit. The coals which are shipped to these railways now stand about 17s. per ton f.o.b., so that 10s. 2d. is left to cover freight, &c. It is evident that there is no expectation of freight rates appreciating or of the coals costing the shippers more under the stabilisation scheme.

Coalfield Wage Claim and Counter-claim.

The South Wales coalowners have given notice of their intention to apply for a reduction in the minimum of 28 per cent. on the standard rate to 25 per cent., and for the subsistence wage of 8s. 0½d. per day to be reduced to 7s. 6d. in respect of married men and the allowance in respect of the single men to be abolished. The men's side have met this with a counter-claim that the minimum of 28 per cent. on the standard rate shall be raised to 35 per cent., and that the subsistence wage shall be increased from 8s. 0½d. to 8s. 6d. per day. The whole matter will come up for discussion at a meeting of the Coal Conciliation Board fixed for the 12th inst. The South Wales industry during the three months—August, September and October—as shown by the audit, reveals an even more unsatisfactory position than for the preceding three months. The accountants certify that after deducting costs other than wages from the proceeds, the percentage from December is 6·94 per cent. below the 1915 standard base rates, compared with a wage rate of ·45 per cent. above the 1915 standard rates in the previous three months. As, however, the agreement secures for the workmen a minimum percentage of 28 per cent. on the 1915 standard base rates, colliery owners will for the next three months again have to bear the whole burden of the difference between the percentage certified and the percentage payable. The actual trading loss suffered by the industry in the three months ending October was £656,838, which is equivalent to 1s. 3·52d. per ton on the output, compared with a loss in the previous three months of £573,929, or 1s. 0·36d. per ton. Over the nine months the accumulated loss amounts to £1,447,543. The average pithead proceeds were 13s. 10½d., compared with 14s. 5½d. in the preceding three months, while the quantity of coal produced was 10,155,097 tons, compared with 11,138,718 tons.

Anglo-French Coal Trade.

Representatives of South Wales coalowners and exporters on Tuesday met representatives of the French coal importers at Cardiff for the purpose of discussing questions of mutual interest regarding the coal trade, and it is interesting to note that according to an interview with Monsieur Victor Miral, the President of the French Coal Importers' Association, the French decree respecting the licensing of coal imports into France is, to all intents and purposes, about to be abrogated. He states that no official action has so far been taken, but it is expected that a decree cancelling the present licensing system will be signed by the end of this year. At the moment, he stated, the system is still in force, but its operation is rather lax.

Steel Plates.

At a recent meeting of the Cardiff Development Committee, the suggestion was put forward by a member that Cardiff shipowners, when ordering new tonnage, should specify that Cardiff steel plates should be used in the construction of the ships. The Committee endorsed this view. It is interesting to note in this connection that since the national coal stoppage of last year, Cardiff shipowners have given orders for forty-one new steamers, having an aggregate deadweight capacity of about 340,000 tons, representing a value of about £3,250,000.

Current Business.

Day-to-day operations on the steam coal market have been very restricted. The conditions have been almost lifeless, and prices have certainly shown no improvement. Poor as the inquiry has been, the majority of colliery salesmen have shown no disposition to reduce their prices further, and it has been a case of secure the present quotations or suspend operations at the pits. From all accounts, progress is being made with the details of the scheme for grouping collieries and fixing minimum prices to apply to both steam and anthracite coals, but it is unlikely that it can be completed and approved so as to come into operation before the New Year.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 16 0	—
No. 1 Foundry	3 17 6	—
No. 3 Foundry	3 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 7 6	3 7 6
Silicious Iron	3 7 6	3 7 6
No. 3 G.M.B.	3 5 0	3 5 0
No. 4 Foundry	3 4 0	3 4 0
No. 4 Forge	3 3 6	3 3 6
Mottled	3 3 0	3 3 0
White	3 3 0	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 6 0	—
(3) Northampton—		
Foundry No. 3	3 0 6 to 3 1 0	
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 6 to 3 6 0	
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0 to 3 5 0	
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 4 0 (a) / 4 7 0 (b) / 4 10 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 15 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	12 10 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	12 5 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 10 0 to 10 0 0	
Marked Bars (Staffs.)	13 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	
Gas Tube Strip	11 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, ¼in.	8 15 0 to 8 17 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 12 6	£13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
MANCHESTER—		
Bars (Round)	8 10 0	—
„ (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 7 6	—
„ (Lancs. Boiler)	10 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 12 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	6 10 0	—
Hoops	10 0 0 to 10 10 0	
Soft Wire Rods	9 0 0	—
MIDLANDS—		
Small Rolled Bars	7 12 6 to 8 0 0	
Billets and Sheet Bars	6 5 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	13 5 0 to 13 10 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	17/9 to 18/–
Block Tin (cash)	269 15 0
„ (three months)	265 10 0
Copper (cash)	60 10 0
„ (three months)	£0 15 0
Spanish Lead (cash)	22 8 9
„ (three months)	22 15 0
Spelter (cash)	26 15 0
„ (three months)	26 10 0
MANCHESTER—	
Copper, Best Selected Ingots	66 10 0
„ Electrolytic	67 10 0
„ Strong Sheets	90 0 0
„ Tubes (Basis Price), lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
„ Condenser, lb.	0 1 1½
Lead, English	23 15 0
„ Foreign	22 12 6
Spelter	26 17 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 17 6	7/3
„ „ 8 p.c. to 10 p.c. „	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 0 0	11/6
„ „ „ 1 p.c. carbon	£41 10 0	15/–
„ „ „ 0·70 p.c. carbon	£53 0 0	17/6
„ „ „ carbon free	1/4 per lb.	
Metallic Chromium	3/– per lb.	
Ferro Manganese (per ton)	£12 0 0 for home, £16 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 15 0 scale 5/– per unit	
„ „ 75 p.c.	£20 5 0 scale 6/– per unit	
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/– per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/3
„ „ Splint	17/– to 19/–
„ „ Trebles	14/6
„ „ Doubles	14/–
„ „ Singles	10/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	15/6
„ „ Trebles	14/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/– to 13/–
Screened Navigation	18/–
Trebles	14/3 to 16/6
Doubles	14/–
Singles	10/6 to 11/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9
Secondary Steam	12/3
Trebles	14/–
Doubles	14/–
Singles	10/6

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/–
Household	40/– to 56/–
Coke	22/6 to 23/6
NORTHUMBERLAND—	
Best Steams	13/6 to 14/–
Second Steams	12/9 to 13/–
Steam Smalls	9/– to 9/9
Unscreened	13/– to 13/6
Household	21/– to 27/–
DURHAM—	
Best Gas	15/9
Second	13/9 to 14/–
Household	21/– to 27/–
Foundry Coke	19/– to 26/–

SHEFFIELD—	Inland.
Best Hand-picked Branch	28/– to 30/6 —
Derbyshire Best Bright House	21/6 to 22/6 —
Best House Coal	21/– to 21/6 —
Screened House Coal	18/– to 19/– —
„ „ Nuts	16/– to 17/6 —
Yorkshire Hards	14/6 to 16/6 —
Derbyshire Hards	15/– to 17/– —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/– to 7/– —
Smalls	3/– to 4/6 —
Blast-furnace Coke (Inland)	11/6 to 12/– at ovens —
Furnace and Foundry Coke (Export), f.o.b.	16/6 to 17/6

(9) SOUTH WALES

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/– to 19/6
Second Smokeless Large	18/6 to 19/–
Best Dry Large	18/3 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/6 to 18/–
Western Valley Large	17/– to 17/6
Best Eastern Valley Large	17/– to 17/6
Ordinary Eastern Valley Large	16/6 to 17/–
Best Steam Smalls	12/3 to 12/9
Ordinary Smalls	11/– to 12/–
Washed Nuts	18/– to 20/6
No. 3 Rhondda Large	19/6 to 20/–
„ „ Smalls	14/9 to 15/3
No. 2 „ Large	16/– to 16/6
„ „ Through	14/6 to 15/6
„ „ Smalls	13/– to 13/6
Foundry Coke (export)	30/– to 37/6
Furnace Coke (export)	27/6 to 30/–
Patent Fuel	22/6 to 24/–
Pitwood (ex ship)	28/– to 28/3
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	32/– to 34/–
Seconds	26/– to 29/6
Red Vein	20/6 to 25/–
Machine-made Cobbles	35/– to 40/–
Nuts	38/6 to 42/6
Beans	22/6 to 26/–
Peas	17/– to 19/–
Breaker Duff	8/6 to 9/–
Rubbly Culm	7/9 to 8/–
Steam Coals:	
Large	18/– to 19/–
Seconds	16/– to 17/–
Smalls	9/9 to 10/9
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' works. (3) f.o.b. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 7/6 joists and 5/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Steel Prospects.

THE forthcoming meeting of the Steel Cartel hardly seems likely to bring the question of an international sales' organisation nearer to solution. It has been impossible, so far, to bring into line the dissident Belgian rolling mill owners, and although further concessions have been offered to them in the way of a larger quota they still refuse to join the combination, from which it is inferred that they object to the plan on principle. It is obvious that, with the Belgian franc stabilised at a much lower figure than the French, they have a great advantage in selling their material abroad, so long, that is, as the level of living costs does not rise sufficiently to eliminate that advantage. Some of the Belgian mill and forge owners, therefore, do not want to enter into a combination which will necessarily reduce their export trade; but the French argue that an uncompromising attitude on the part of the Belgians may result in disaster to them, owing to the fact that there appears to be a lessening consumption of steel in Germany and that, as soon as the Germans find it necessary to export, there will be a recrudescence of runious price cutting. Meanwhile, negotiations for the creation of national *comptoirs* in this country are making slow headway on account of the difficulty of reconciling everybody to their proposed quotas. The sole object of mill and forge owners now is to advance prices, and on the international market they have already hardened.

Railway Deficits.

While in 1926 the French railways showed, for the first time, a satisfactory balance, the fall in traffic receipts this year is so heavy that there is likely, it is said, to be a total deficit of something like 1000 million francs. The trade depression is largely responsible for the decline, but still more is attributed to the increased railway rates, which have, of themselves, helped to intensify the industrial slackness, and there is a falling off not only in goods traffic but also in the number of passengers carried. As the railway companies have to depend entirely upon themselves, the Conseil Supérieur des Chemins de Fer is required, whenever the returns show a deficit, to suggest measures for making it good, and it is now faced with the problem of providing for a deficit, which is far more considerable than could have been anticipated. There can be no question of putting up railway rates still further, for experience has shown sufficiently that an increase is followed, after a time, by a reduction in traffic receipts. Moreover, the increases made last year were due mainly to fiscal taxes, which are as much as 33 per cent. on passenger tickets, and it is argued that a first reform must consist in a reduction of taxes on railway transport, which are far higher than those imposed on any other transport industry. Another cause of the deficit is the enormous addition to charges resulting from the operation of the eight hours' day, whereby the number of railwaymen had to be increased by one-third. A repeal of the eight hours' working day may be more difficult of accomplishment even than a reduction of taxes, and as neither can be relied upon, the railway companies are preparing to effect all the economies they possibly can in working costs. All new works are to be postponed, unless they are of special urgence, and the local lines, which are nearly all running at a loss, will be transformed, principally with the aid of motors. Where the traffic is very small some trains will be suppressed and the service will be effected by road vehicles. The number of railwaymen will be reduced, travelling gangs will be required to do the work of men who are now stationed at fixed points, and men who have been pensioned off may be liable to return to sedentary duties. The situation is so serious that the problem can only be solved by drastic measures.

Railway Electrification.

Except on the Midi line, on which the conditions are specially favourable for electrification, the enthusiasm for a general electrical equipment of railways appears to have abated, or at least it is tempered by a prudent desire to wait until the railways already electrified are able to show an economy over the old system. On the Paris-Orleans line there is a great improvement in the service, but, owing to the heavy first cost and maintenance charges, it has not realised the economies expected. At the moment the only scheme which is receiving support is the proposed electrification of the Alsace-Lorraine system. Now that the company known as the Energie du Rhin is practically constituted for the construction of the Kembs Barrage, which is to be the first section of the Alsace Canal, it is claimed that the electrical energy available, together with that supplied by the other power stations on the Rhine, will enable the Alsace-Lorraine railways to be equipped under economical conditions. The Strasburg Chamber of Commerce has decided to carry out an inquiry into the technical and financial aspects of the question.

Algerian Floods.

In view of the extensive system of hydraulic works which is being carried out in Algeria, the devastation caused by the recent floods shows the necessity of providing for a much larger margin of safety than is usually regarded as essential in a country where the rainfall, although occasionally heavy, is rarely of long duration. At Mostaganem the *oued*, which comes from the mountains two and a-half miles distant, passed through the town in a tunnel at the bottom of the ravine which was filled and built upon. After a heavy rain, followed by a deluge lasting thirty-six hours, the water came down from the mountains, blocking the tunnel and, rising above the ravine, flooded the town and the surrounding district. The tunnel burst and destroyed all the houses above it, involving a heavy loss of life. The bursting of the barrage across the Ferghangs *oued* also inflicted disaster on the town of Perregaux, but thanks to the vigilance of the engineer in charge of the power station, who gave the alarm when he saw that a collapse appeared inevitable, the whole population was able to escape the rush of 10 million cubic metres of water.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

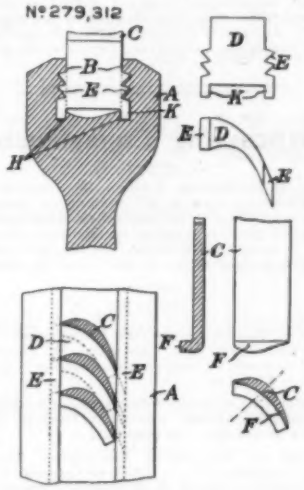
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

279,312. March 10th, 1927.—IMPROVEMENTS IN AND RELATING TO ELASTIC FLUID TURBINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Frederick Samuelson, of Holyrood, 44, Hillmorton-road, Rugby.

In turbines of the reaction type having narrow spacing blocks between rotor blades placed at an angle to the axial flow direction, the spacing blocks are not self-locating in the blade root groove, but are free to twist. This invention is intended to overcome this objection. The rim A of the rotor wheel is provided with a circumferential groove B for the reception of the roots of the blades C in the usual manner, separated by spacing blocks D. The spacing blocks are held in place by means of

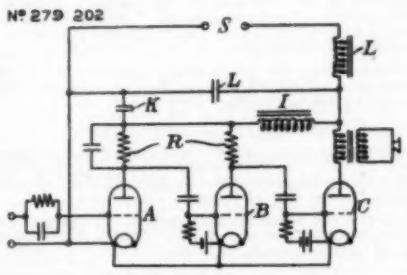


serrations E co-operating with a similar formation in the sides of the groove B and the blades are held by means of a one-sided projection F at the foot fitting underneath the adjacent spacing block. Projections on both sides may be used, or the blades may be held by means of serrations in the same manner as the spacing blocks, or any other blades or blade fastening may be employed. As shown in the lower left-hand drawing the angularity of the spacing blocks would permit of their turning in the groove, and not being correctly located at the correct blade angle during assembly. To avoid this two additional circumferential grooves H at the base of the groove B are provided for the reception of radially-extending lugs K on the spacing blocks. One or more lugs K each with its groove H may be provided.—*October 27th*, 1927.

TELEGRAPHS AND TELEPHONES.

279,202. August 21st, 1926.—IMPROVEMENTS RELATING TO THERMIONIC VALVE AMPLIFIER CIRCUITS, the British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Thomas Hilary Kinman, of "Ladbroke," Bilton, Rugby.

The diagram shows a three-valve amplifier of known form embodying resistance-capacity-coupling between the detector valve A and the first stage amplifier B, and between this valve and the power amplifier valve C. The plate potential for each of these valves is supplied from the souce S, which may be any suitable source of direct current potential, such as a power supply main or rectified source of alternating current. To smooth out fluctuations in the supply voltage, a filter circuit comprising a choke coil and condenser L L are connected as shown. It has been found that, during operation, there is a tendency for oscillations,

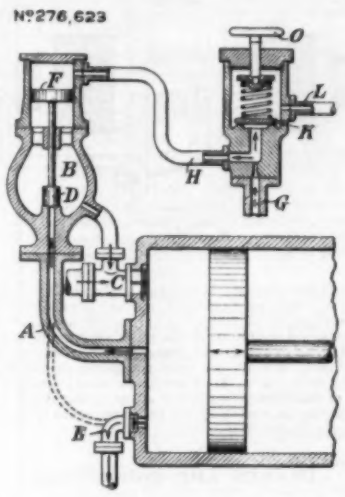


corresponding closely to the natural frequency of the filter circuit, to be generated by the amplifier, and to prevent these oscillations from reacting on to the grids of the valves, an impedance I and condenser K are connected between the points from which the supply to the power valve C is taken, and the resistance-capacity-coupling stages. The function of the impedance I is solely to prevent reaction feed back from the filter circuit, and it is desirable that the ohmic resistance of I, which may be an inductance or a pure resistance, should be small compared with the external coupling resistances R, so that only a relatively small loss of voltage is produced across the impedance I. Where the value of resistance R is high, a pure resistance of the order of 20,000 ohms may be used for the impedance I, and the value of K may vary from about 2 to 10 microfarads.—*October 27th*, 1927.

PUMPING AND BLOWING MACHINERY.

276,623. May 12th, 1927.—IMPROVEMENTS IN OR RELATING TO RECIPROCATING COMPRESSORS, Sulzer Frères Société Anonyme, of Winterthur, Switzerland.

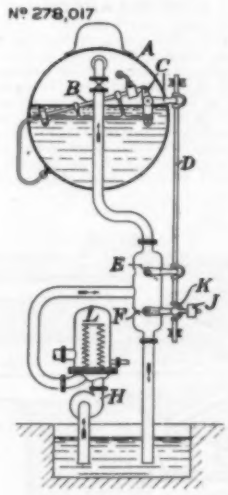
This invention relates to a reciprocating compressor of the kind having a relief or safety valve through which gas may pass from the working space of the cylinders back into the suction pipe during the delivery stroke when the delivery pressure is excessive. The working space of the cylinder is connected by a conduit A with a valve chamber B in constant communication with the suction pipe C. A relief or safety valve D controls the conduit A. In some cases the passage A may lead to the delivery pipe E instead of communicating directly with the compression cylinder. The spindle of the valve D carries a piston F mounted in a cylinder to which oil or other liquid under pressure is supplied by a pump (not shown) through pipes G and H connected to the



casing of a relief valve K having a discharge pipe L. The valve K is controlled by a spring, the pressure of which can be adjusted by means of a hand wheel O, and the arrangement is such that if the pressure of fluid in the compressor or delivery pipe exceeds a predetermined value, the relief valve D is lifted from its seat against the pressure of the oil acting on the piston F, the oil displaced being returned to the suction side of the pump through the pipe L. If the pressure of the spring is reduced by adjusting the hand wheel O, the relief valve D is unloaded and the charge of air or gas drawn in by the working piston is returned, uncompressed, through the valve D to the suction pipe. The valve D can thus readily serve both as a safety valve and as a means of avoiding or relieving compression during the starting period. Further, the operation of a single control device, such as the hand wheel O, will simultaneously influence the various stages of a multi-stage compressor.—*October 27th*, 1927.

278,017. September 27th, 1927.—IMPROVEMENTS IN OR RELATING TO REGULATING APPARATUS FOR THE FEEDING OF STEAM BOILERS, Aktiengesellschaft Brown, Boveri & Cie, of Baden, Switzerland.

Centrifugal feed pumps have the peculiarity of warming up in consequence of the frictional work of the wheels in the water as soon as the quantity of water delivered falls to a small value or to zero, and the object of this invention is to avoid this trouble. A is the upper drum of a steam boiler. B is a feed-water regulator in the form of an expansion tube. According to the position of the surface level of the water a shorter or longer



part is heated by steam, as a result of which its length varies according to the water level. The change of length is transmitted by means of a bell-crank lever C and a connecting-rod D to a feed valve E. Before complete closure of the feed valve E, a no-load valve F is opened, which ensures the circulation of a definite quantity of cooling water through the feed pump H which is consequently cooled. The no-load valve F is kept closed by a weight J, the intermediate piece K permitting unhampered movement of the feed valve E. L is a preheater which is traversed by the feed water and is likewise protected by its position in the no-load circuit against excessive heating, when the feed valve is closed.—*October 27th*, 1927.

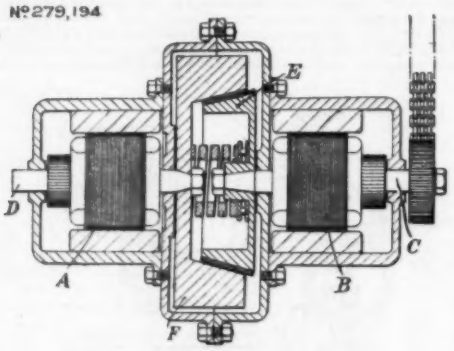
MOTOR CARS AND ROAD TRAFFIC.

279,194. August 10th, 1926.—IMPROVEMENTS IN AND RELATING TO ELECTRIC STARTERS FOR INTERNAL-COMBUSTION ENGINES, Ralph Leonard Aspden, of 6, Southport-road, Chorley, Lancaster, and the Aspden Flywheel Dynamotor Syndicate, Ltd., of 75, Windsor House, Victoria-street, London, S.W. 1.

An electric starter for motor car vehicles constructed in accord-

ance with this invention can be rotated at high speed before being connected to the engine. The motor armature A and the dynamo armature B are mounted on separate shafts. The shaft C is provided with a silent chain sprocket, which is connected by a chain to the engine shaft. At the other end of this shaft there is a cone clutch E, which engages with a fly-wheel F, on the shaft D, the clutch and fly-wheel being separated by a spring. The shaft D can slide in its bearings, but the armature of the dynamo and its shaft are fixed. By means of a clutch or other arrangement the dynamo and motor may be rigidly connected. In operation the dynamo armature is continuously

No 279,194



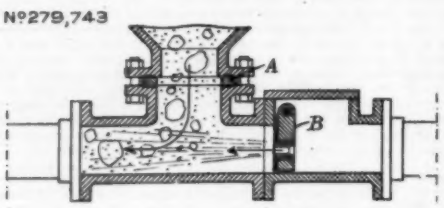
driven from the engine. When the engine is stationary, however, and it is desired to start it, current is switched on to the motor armature, which rotates at high speed and when sufficient speed is attained the motor armature is pushed by means of a pedal and made to engage the dynamo armature by means of the clutch and thus through the chain rotate the engine shaft, when the engine will start. If desired, automatic means may be provided so that the current is cut off when the motor is actually turning the engine, and thus only the momentum is used to start the engine.—*October 27th*, 1927.

CRANES AND CONVEYORS.

279,743. June 14th, 1927.—Ash-handling Plant, A. Zöbelein, 24, Felsenstrasse, Nürnberg, Germany.

The inventor aims at the simplification of ash conveyors in which the ashes are conveyed by a current of high-pressure water by using one pipe as conveyor and for the water supply. The pipe passes under the several ash hoppers, and at each there is a slide A

No 279,743



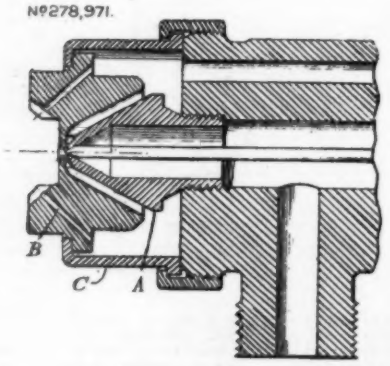
for shutting off or admitting the ashes to the pipe. In front of each hopper there is arranged in the pipe a flap valve B, which can be operated by a handle without. In the centre of the valve there is a water nozzle. With the flap valve shut a strong jet of water is provided to propel the ashes, while with it open a free passage is provided for ashes coming from other hoppers to the right.—*November 3rd*, 1927.

MISCELLANEOUS.

278,971. April 2nd, 1927.—Spraying Jets, M. J. W. Binks, 741, Fair Oaks-avenue, Oak Park, Illinois.

The inventor says that in spraying devices, such as those used for painting, in which the spray is flattened by opposed intersecting jets of air, difficulties are generally experienced through departure from a proper aligning of the parts through which the liquid and the air are projected. To insure uniformity of the resulting spray, the initially projected cylindrical stream of liquid is commonly sheathed by an initially cylindrical tube of air. If the parts between which this tubular sheath of air

No 278,971.

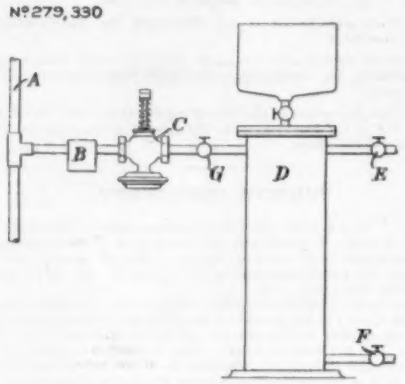


is projected are not concentric, the sheath will vary in thickness, thereby causing corresponding variations in the atomisation. So also, if the axis of the initially projected cylindrical stream of liquid does not bisect the angle between the converging lateral air jets, the desired uniformity of atomisation cannot be obtained. In order to provide an easily machined form of nozzle he makes it of two parts A and B, both of conical form, in which the necessary passages are cut. The two parts are held together by a loosely fitting cap C, and rely for their concentricity on the coned faces, which can be easily made accurate.—*October 20th*, 1927.

279,330. April 22nd, 1927.—Improvements in and relating to Water Softening Systems and Apparatus, John Nelson Dundas Heenan, of Aldwych House, Aldwych, London, W.C. 2.

The object of this invention is to limit the rate of flow through the softener to the maximum rate for satisfactory operation irrespective of variations in the supply pressure and demand for softened water. In the accompanying diagram A designates the water supply main, B a water meter, C a constant flow controlling valve, D the water softener fitted with cocks E and F in the usual manner. A valve or cock G is interposed between

No 279,330



the valve C and softener D. However much the pressure in the supply main or the demand for softened water may vary, the flow through the softener does not exceed a predetermined maximum and water cannot be drawn at a rate exceeding that for which the softener is designed. Means are provided on the valve for adjusting the flow as required.—*October 27th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institute of Metals: Sheffield Local Section.—Applied Science Department of the University, St. George's-square, Sheffield. "Stresses in Non-Ferrous Castings," by Professor C. H. Desch. 7.30 p.m.

Institution of Chemical Engineers.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Conference. For programme, see page 608.

Institution of Mechanical Engineers.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. "Economics in Engineering," by Major S. J. Thompson. 7 p.m.

Institution of Water Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Winter general meeting. "Rainfall and Flow-off, River Garry, Inverness-shire," by Captain W. N. McClean; "Underground Water Supplies, and the Need for Investigation of the Sources Thereof," by Mr. S. R. Raffety; "Failure of Slow Sand Filtration in Madras City," by Mr. J. W. Madeley. 10.30 a.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W 1. "Management Graphics," by Mr. T. G. Rose. 7.30 p.m.

Keighley Association of Engineers.—Room 14, Temperance Institute, Keighley. Lecture, "The National Importance of the Low-temperature Carbonisation of Coal," by Mr. H. P. Hird. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Informal meeting. Discussion on "The Relation Between the Drawing Office and the Shipyard and Engine Works," introduced by Mr. C. Waldie Cairns. 7.15 p.m.

Physical Society.—Imperial College of Science, South Kensington, London, S.W. 7. Papers: "The Scattering of Light by Individual Particles in Smokes," by Mr. H. P. Walmsley; "On the Construction and Standardisation of an Interferometer Pressure Gauge," by Mr. J. J. Manley; "The Dielectric Constant of Liquid Bromine," by Anne I. Anderson. 5 p.m.

MONDAY, DECEMBER 12th.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Age-hardening of Alloys," by Dr. R. Ray. 7.30 p.m.

Institution of Automobile Engineers.—The College, Loughborough. Loughborough Graduates' meeting. Paper, "Electrical Equipment," by Mr. J. H. Parker. 7 p.m.

Institution of Automobile Engineers: Birmingham Centre.—Queen's Hotel, Birmingham. Paper, "Experiments on the Behaviour of Various Gaseous Fuels in a High-speed Internal Combustion Engine," by Dr. A. F. Burstall. 7 p.m.

Railway Club.—25, Tothill-street, London, S.W. 1. Paper, "The Story of a Derelict Line—the Chesterford and Newmarket Railway," by Mr. K. Brown. 7.30 p.m.

TUESDAY, DECEMBER 13th.

Illuminating Engineering Society.—E.L.M.A. Lighting Service Bureau, 15, Savoy-street, Strand, London, W.C. 2. Paper, "An Investigation of Electric Lighting in the Engineering Industry," by Mr. J. L. H. Cooper. 6 p.m.

Institution of Automobile Engineers: Coventry Centre.—Broadgate Café, Coventry. Paper, "Control in Carburation," by Mr. W. A. Whatmough. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Paper, "The Reconstruction of Two Railway Swing Bridges between Ipswich and Great Yarmouth," by Messrs. K. B. Turner and R. E. Walsh. 6 p.m.

Institution of Electrical Engineers: Scottish Centre.—Room 149, Royal Technical College, George-street, Glasgow. Paper, "The Stability of Large Power Systems," by Mr. F. H. Clough. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Detonation in Motor Fuels," by Mr. H. R. Ricardo. 5.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "A Year's Work in X-ray Crystal Analysis," by Sir William Bragg. 5.15 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Chilled Rolls," by Mr. A. Allison. 7.30 p.m.

WEDNESDAY, DECEMBER 14th.

Institution of Automobile Engineers.—Birmingham Graduates' visit to the works of the Sunbeam Motor Car Company, Ltd., Wolverhampton. 2.30 p.m.

Institution of Automobile Engineers: North of England Centre.—The Engineers' Club, Manchester. Paper, "The Modern Motor 'Bus," by Mr. G. J. Rackham. 7 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Students' meeting. Paper, "The Reconstruction of Paddington Goods Station, Great Western Railway," by Mr. E. C. Cookson. 6.30 p.m.

Institution of Engineers-in-Charge.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Lubrication and Lubricating Oils," by Mr. S. E. Bowrey. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. "Ship Ventilation," by Mr. H. Caird. 7.15 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "The Evolution of Modern Road Surfaces," by Major R. G. H. Clements. 8 p.m.

Society fo Glass Technology.—University College, Gower-street, London, W.C. 1. Papers: "The Analysis of Opal Glasses," by Mr. J. H. Davidson and Miss V. Dimbleby; "The Durability of Iron-containing Glasses," by Miss V. Dimbleby and Professor W. E. S. Turner; and "The Effect of Iron Oxide on the Properties of Glass," by Dr. S. English, Mr. H. W. Howes, and Professor W. E. S. Turner. 2.30 p.m.

THURSDAY, DECEMBER 15th.

Institute of Metals: Birmingham Local Section.—The Engineers' Club, Waterloo-street, Birmingham. "Duralumin," by Dr. L. Aitchison. 7 p.m.

Institute of Patentees.—Caxton Hall, Westminster, London, S.W. 1. "The Commercialisation of Inventions in this Country," by Mr. A. Ryner. 8 p.m.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. London Graduates' meeting. Paper, "Lubrication of, and Lubricants for, Petrol Engines," by Mr. C. I. Kelly. 7.30 p.m.

Institution of Civil Engineers: Birmingham and District Association.—Chamber of Commerce, New-street, Birmingham. Lecture, "Some Notes on Highway Bridges," by Captain C. G. Mitchell. 6 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Squirrel-cage Induction Motors," by Mr. D. B. Hoseason. 6 p.m.

Institution of Mechanical Engineers.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 6.45 for 7.15 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Petroleum Natural Gases and their Derivatives," by Mr. J. Kewley. 5.15 p.m.

FRIDAY, DECEMBER 16th.

Chemical Engineering Group.—Electricity Lecture Theatre of the University, Liverpool. Paper, "Oil Pollution of Seas and Harbours—and a Remedy," by Mr. C. S. Garland. 6 p.m. Visit to the ss. Adda at Liverpool Docks. 2.30 p.m.

Institution of Locomotive Engineers: Manchester Centre.—College of Technology, Sackville-street, Manchester. Short papers by Messrs. G. C. R. Parker and R. C. Bond. 7 p.m.

Institution of Locomotive Engineers: North-Eastern Centre, Leeds Area.—Hotel Metropole, Leeds. Paper, "Piston Gland Packing, and Coupling and Connecting-rod Lubrication," by Mr. C. F. Adams. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Some Experimental Results from a Three-cylinder Compound Locomotive," by Mr. Lawford H. Fry. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Paper, "Hardening and Quenching Throughout the Ages," by Mr. P. J. Haler. 7.30 p.m.

Polytechnic Engineering Society.—309, Regent-street, London, W. 1. Annual conversazione. (Tickets obtainable from the Secretary.) 7.30 p.m.

SATURDAY, DECEMBER 17th.

Institution of Automobile Engineers.—London Graduates' visit to the Barking power station of the County of London Electric Supply Company. 2.30 p.m.

Institution of Civil Engineers.—Students' visit to the testing and experimental station of David Kirkaldy and Son at Southwark, S.E.

WEDNESDAY, DECEMBER 21st.

Crystal Palace School of Practical Engineering.—Crystal Palace, London, S.E. 165th Award of Certificates. 3 p.m.

Institution of Civil Engineers: Manchester and District Association.—Literary and Philosophical Society's Rooms, 36, George-street, Manchester. Paper, "Notes on Sewage Works Design (Activated Sludge Process)," by Mr. W. H. G. Mercer. 6.45 p.m.

CONTRACTS.

The B.E.N. Patents, Ltd., of 92, Tottenham Court-road, London, W. 1, has received the following orders for B.E.N.-Myers car washing plants:—(*a*) A four-gun plant for the *Evening Standard*, and (*b*) a four-gun plant for the Edinburgh Corporation. The last named is for washing tramcars.

The Westinghouse Brake and Saxby Signal Company, Ltd., has been instructed by the Crown Agents for the Colonies to supply for use on the railways of the Federated Malay States a large quantity of signalling materials, amongst which are included many types of fittings, such as cranks, compensators, lock bar clips, &c., fitted with Westinghouse anti-friction roller bearings.

Light Railways, Ltd., of 2, London Wall-buildings, London, E.C. 2, has received orders for (*a*) five broad-gauge tank wagons for the Bombay, Baroda and Central India Railway; (*b*) sixteen for the East Indian Railway; and (*c*) five metre-gauge petrol tank wagons for the Madras and Southern Mahratta Railway. These vehicles are being manufactured in Belgium by the Société Anonyme des Ateliers de Construction de Familleureux.

The Institution of Electrical Engineers.—It has been decided to hold in future the associate-membership examination in England in May and November annually, the next examination taking place in May, 1928. Entry forms should be submitted to the Secretary, Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2, from whom all particulars may be obtained, by April 1st for the May examination and by October 1st for the November examination.